# N.A.A. BULLETIN

*September 1958*

*In Three Sections*
*Section 1*

## Your Company and the Economy

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## Accounting for Nuclear Reactors

•

## Budgeting For —

Operations

Research and Development

# N.A.A. BULLETIN

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# Economic Yardsticks in Management Reports

by JOHN H. KEMPSTER

BUSINESS OWNERS AND MANAGERS have always been interested in a framework for judging results of their companies' operations. Each management knows that the growth, productivity and profitability of its company needs to be tested, not only against its own standards and history but also against the results that others are achieving or have achieved. It is the purpose of this paper to illustrate some of the ways in which economic comparisons can be built into accounting reports, especially regular graphical and written presentations to management. The illustrations which will be used are drawn largely from the presentations we have found to be effective in my own company, a paper products manufacturer. At the same time, a review of the writings on this subject, along with the discussions I have had with others interested in it, lead me to believe that most of these illustrations have fairly wide application. Also, most of the industry statistics which are used are available to all from government economic sources.

There are all kinds of economic yardsticks, which can be used in connection with a company's operating data, including stock market averages, industrial production indices, and commodity prices, to mention a few. But the things which are uppermost in the minds of managers when they are reviewing company plans and operations are not a welter of statistics, internal and external, but questions of performance in a few areas. Four of these key interest areas of management are as follows, and these are the ones at which the illustrations in this article will be directed:

1. Long-run growth—principally sales growth—both company and product line.
2. Current market performance—principally sales performance against budgets and against competition—relative to current business conditions.
3. Factory performance and productivity—and trends in prices of materials, wages, and the trend of costs.
4. Earnings power—including profit margins, net profit, return on investment, and dividends.

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It is possible to say that the first two areas are the primary concern of marketing management, the third the concern of production management and cost accountant, and the fourth the primary concern of financial management. This may be true, and rightly so; yet, in many companies, it is the accountants who do the reporting in all these areas. If so, it is accountants who must probably carry the load in developing whatever yardsticks of comparisons are used to give the reports added meaning and significance.

### *Long-Run Growth — The Company vs. National and Industry Trends*

One presentation we have found useful is a graph which shows the long-run trend of our company's total sales in relation to the growth of the nation's business and its population. The two yardsticks which are used are gross national product and population. The former series is taken from the *Survey of Current Business* published by the U. S. Department of Commerce Government Printing Office; this is a principal source of gross national product statistics and other industry data. For this purpose, we leave out of the picture the effect of changing prices by using gross national product at a constant price and by using our own company price index to put our own sales also on a constant dollar basis. The resulting graph is shown as Exhibit 1. The charts and tabulations in this article are illustrative only, the figures for "our company" being fictitious. The government figures, however, have not been altered but, in some cases, the illustrations represent estimates for the year 1957.

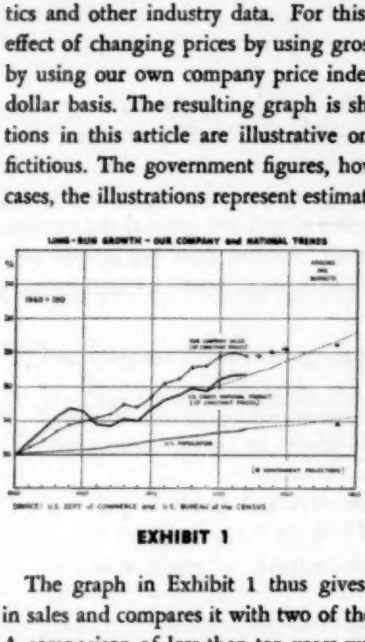

**EXHIBIT 1**

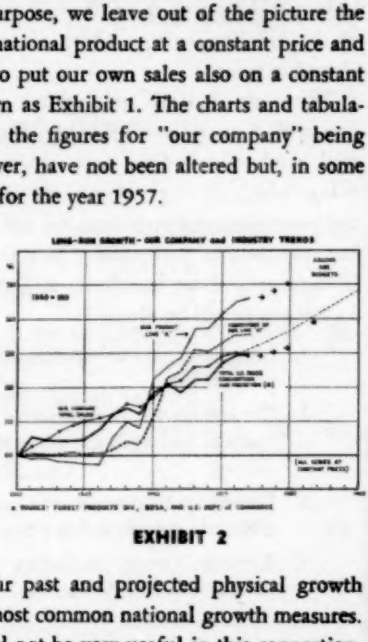

**EXHIBIT 2**

The graph in Exhibit 1 thus gives our past and projected physical growth in sales and compares it with two of the most common national growth measures. A comparison of less than ten years would not be very useful in this connection, although year-to-year ups and downs can be significant. For a company such as ours, with an established national market for most of its products, we know

that we should at least move along with the nation as a whole. The projections given for gross national product are the official ones of President Eisenhower's Council of Economic Advisors and for population are the latest estimates of the Bureau of the Census. For our own company, we have indicated our latest three-year budget. Only full annual figures are used, although some interim figures are available, at least on a quarterly basis.

Another long-run comparison which can be readily made is that of our own dollar sales against the Department of Commerce manufacturers' sales figures for our industry. This appears in Exhibit 2 and, in the same chart, we have shown Product Line A and a trade association sales figure which we have for the industry sales of this product. Such a chart as this is repeated for each product line of our company.

The comparison here is much more specific than Exhibit 1, which used gross national product, but it can also be a more difficult one to prepare. One reason it may be difficult is that the manufacturers' sales figures of the U. S. Department of Commerce are broken down only into broad industry groups. We are a paper products manufacturer so we can use "paper and allied products" sales as one standard of comparison, even though we know that the industrial classification represented includes all types of paper and paper products making, some parts of which are unrelated to our operations. If we produced cosmetics or dishware, our problem would be even more difficult at this level, because the Department of Commerce sales figures would hardly identify our industry for us. Sometimes a trade association figure for industry sales can be used instead. Trial, error, and improvisation may be necessary. If no "industry" figures are available, direct exchange of sales information with other companies on an index number basis can be used. Or, you can assemble your own "industry" from Moody's Industrials or other manual. An excellent bibliography of sources is the *Distribution Data Guide,* issued monthly by the U. S. Department of Commerce, Government Printing Office.

Turning now to product line growth, the standard of comparison would probably have to be a trade association figure unless the government statistics happened to be very detailed. In Exhibit 2, after showing our company sales against the paper and allied products industry, I have shown our Product Line A against a trade association figure for the same type of products. The resulting picture is one which shows both the company sales and Product Line A sales against total industry sales and the industry sales of this product group. As was indicated before, on the charts like this for other product lines, we would report the company and industry sales but would use a similarly appropriate yardstick for the product line, itself, if one is available.

This completes the illustrations on long-run growth and, for regular presentations to top management, these might be sufficient on this topic, i.e., a chart for the total company and a chart for each product line, each using one or more yardsticks. Of course, if this were a detailed study of a product line for use by the marketing and production personnel connected with the line, such presentations as these would be only a starting point. Beyond this, a great amount of detailed information undoubtedly would be brought to bear on the subject. However, Exhibits 1 and 2 do help to answer the general question: What are our growth trends and how do they compare with general business, our industry and identifiable competition? In addition, these same comparisons can be used in everyday reports and discussions on this subject and in connection with forecasting and budgeting.

### *Current Sales Trends — And Realizations*

One counterpart of long-term growth is current sales trends. I am referring here to the week-to-week or month-to-month figures for product sales which are relevant for sales management production and inventory control, and short-run cost and financial planning. Here again, economic yardsticks may be useful, because they may well determine the kind of immediate management tactics which must be adopted. If we see a product line slipping, not only against its own history and budget but also against its competition, we know that something needs correction. It may be product design, service, pricing, sales promotion, or selling effort which is at fault. Our yardstick will not, in itself, give the answer but, if we do not know how others are faring, we may put all the blame on business conditions and not push for corrective action.

Reports which show current market performance must be based on monthly or weekly figures rather than on the yearly figures which are used for showing long-run growth. Also, if possible, "orders received" figures are better than record of sales or shipments, especially if any appreciable production time is involved after receipt of order. In our company, we have "orders received" figures available weekly in units and dollars, by salesmen, by sales districts and divisions, and by product line. Most of these results can be matched immediately against budgets and against the results of prior periods.

All this current sales information is invaluable, as most will agree, but here we also need some of these economic yardsticks to which we have been referring. The natural general economic comparison to make is the progress of our own total company orders received against the orders received of all manufacturers. This information, like all manufacturers sales (with certain industry

breakdowns), is also available from government sources. Unfortunately, the industry breakdowns are not so detailed as they are for sales (billings to customers), but they are better than none. Numerous private sources publish sample results of incoming orders, as do many trade associations. One of the principal advantages of private sources is speed. The U. S. Department of Commerce orders figures are about 30 days behind the time when most companies would know their own orders received (for the month).

In forecasting, budgeting, and reporting orders received, we use economic yardsticks in many ways, but the principal uses are as follows:

1. A forecast of all manufacturers orders (indicate major breakdowns) for the current year issued at the time of budget preparation, three times a year.
2. A monthly report which tabulates and charts our own orders results and those of all manufacturers (including major breakdowns). In some cases, we have trade association figures to match against our individual product lines.
3. A weekly report, issued at the time of our weekly orders report, which comments briefly on the latest available economic yardstick information.

All three of these analyses are integrated with the regular accounting (or sales statistics) reports on these subjects. Also, when presentations are being made to top management, this information on current sales performance can be included.

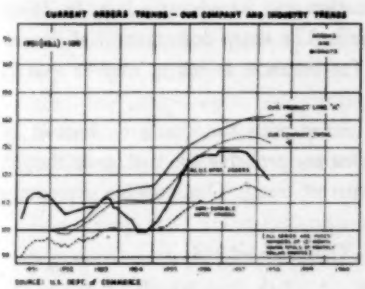

EXHIBIT 3

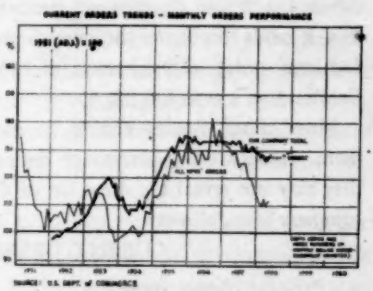

EXHIBIT 4

In Exhibit 3 and in Exhibit 4 are shown two of our charts on current market performance. These fit in with the monthly report referred to in Item 2 of the above list. Exhibit 3 is more or less self-explanatory, but some of its technical features are covered in a comment. From a management point of view, the key function of this chart is that it makes a direct comparison between our own performance and that of industry, both on a total and on a product line basis.

For economic yardsticks, the official U. S. Department of Commerce series on new orders is used and fitted to relate to our own figures. The chart gives both all manufacturers and non-durable manufacturers but, if figures are available, a competitor's line can be used in place of, say, non-durable manufacturers. We have one of these charts for each product line, and the company total and all manufacturers' lines are repeated on each chart.

In Exhibit 3, the *unadjusted* figures for all manufacturers' and non-durable manufacturers' orders are used in constructing 12-month moving totals. These totals are then all divided by a base year total to give a series of index numbers which can be plotted. No attempt is made to "center" the plotting. Thus, each point plotted represents the full 12 months of orders, prior to and including itself. By 1951 (*adjusted*) is meant that the base year for all manufacturers, etc. has actually been adjusted to what it would be if our company orders related to it in 1951 as they did on the average in the five years prior to 1951. This enables us to avoid the distortions involved in a single year base and yet plot our own orders with 1951 as 100 per cent. Thus, departures of our company line from the yardstick actually represent changes from their 1946-50 average relationship.

Exhibit 4 is very much the same as a portion of Exhibit 3, except that monthly plottings, instead of 12-month moving totals, have been used. This chart has its best use only if a seasonally adjusted series for your company orders is available. In Exhibit 3, the use of moving totals removes seasonal ups and downs but it also smooths out the information and introduces a lag. In doing this, it tends to obscure the immediate trend. The sharp downturn of all manufacturers' orders through most of 1957, for instance, is not as easy to spot in Exhibit 3 as it is in Exhibit 4.

Many times, figures should be used, either with the charts or instead of them. In such cases, percentage comparisons are probably the best, even though they may not reveal the direction of the current trend. One possible percentage summary is as follows:

CURENT ORDERS TRENDS—1958

| *Per-cent change from 1957* | *Jan.* | *Feb.* | *March* | *Year to date* |
|---|---|---|---|---|
| Our Company | — 8 | — 6 | — 5 | — 6 |
| Our Product Line A | + 2 | — 4 | + 2 | even |
| Our Product Line B etc. | — 10 | — 7 | — 4 | — 7 |
| Competitors of Product Line A etc. | even | — 6 | — 3 | — 3 |
| All U. S. manufacturers | — 16 | — 16 | — 15 | — 16 |
| Non-durable U.S. manufacturers etc. | — 7 | — 6 | — 6 | — 6 |

A few further comments in connection with economic yardsticks for judging current market or sales performance should be added. First, experience seems to show that the most direct and uncluttered presentations are probably the most valuable, provided they do not oversimplify the story. Dollar figures should be compared with dollar measures, not with non-dollar (or physical volume) measures. Also, it is dangerous to compare orders figures with sales (billings or shipments) figures, unless the timing problems can be satisfactorily resolved. Finally, repeated use of the same yardsticks, providing they are well chosen, will eventually lead to quicker management understanding of the report. At the same time, if a yardstick proves unworkable, there is no need to cling to it. For some types of yardstick purposes, the Federal Reserve Index of Production or one of its many components is valuable. This index is published monthly in the *Federal Reserve Bulletin* and in other economic references.

### *How Does the Company Align With Trends in Productivity, Costs, Prices*

There is hardly room in this article for a discussion of the economic yardsticks which can be applied in connection with reports dealing with factory performance. Direct comparisons with outside information are more difficult in this area than they are in sales performance which deals with markets or in final result comparisons which deal with earnings or dividends. The principal reason for this is that, for most companies, information about competitors or industry costs is simply not available, because this information is typically kept secret. The exceptions to this are the cases in which industry or trade associations have worked out cost comparisons and publish some types of comparative cost information. Such comparisons are most detailed where uniform cost systems have been established.

Fortunately, it is precisely in this area of factory performance that orthodox cost control methods have reached a very high degree of development. The yardsticks which are used, however, are standard costs and budgets, rather than the external economic type of yardstick. In recent years, return-on-investment methods have been added to bolster cost control and strengthen profit improvement methods. But, for the most part—and perhaps properly so—a company develops its standards for factory performance more by studying its own operations than by using external information.

This does not mean that there are no economic yardsticks which can be applied in the cost area. Both wage rates and raw materials prices have long been

subject to quite extensive comparative analysis. And, if we include product selling prices, we recognize another whole area where company figures are compared with outside measures. This leads us to the two examples that are given in this paper of presentations in the cost-price area. Actually, it is the cost-price-productivity area, because productivity is the third member of this well-known triumvirate.

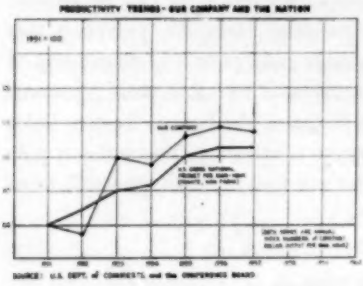

EXHIBIT 5

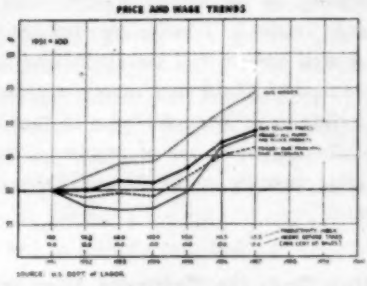

EXHIBIT 6

In Exhibit 5 is a chart which shows our company trend in man-hour productivity matched against a similar measure for the country. For a company in which rate of expansion or changes in methods or products have been very drastic, man-hour productivity changes are very difficult to interpret. In fact, even under the best circumstances, productivity measurement can be troublesome. Nevertheless, more or less sales value per man-hour, taken together with changes in wages, materials costs, and selling prices, are important determinants of profitability. Thus, despite its limitations, we believe that measuring our trends in output per man-hour gives us information which is useful to our management, especially top-management whose interest is in over-all trends. For this purpose, sales value produced, i.e., sales adjusted for inventory changes, is appropriate. Also, it must be measured at constant prices. In our company we use total man-hours, including clerical and management personnel.

In Exhibit 6, the productivity index is repeated, along with chart lines which show trends in wages, material costs and selling prices. The chart indicates that, among other things, the rise in wages in excess of selling prices has more than been offset by increases in productivity. Also shown is the rate at which the company selling prices have kept pace with raw materials prices and prices of paper products generally. The remaining information on this chart is the earning power of the company, as measured by the per cent of income (before taxes). The figures given are illustrative only, but they do show how favorable changes in prices, costs and productivity, influence rate of profit. For a

more complete analysis of changes in profit, it is, of course, necessary to put all the tools of accounting analysis to work and to deal with all the factors which affect profits. This presentation is designed only to show the broad trends. Even it needs to be supplemented by information on such major cost items as depreciation and fringe benefits to be complete enough to provide general answers to questions on profits.

### Comparisons of Earning Power

One thing that is fortunate in selecting yardsticks for profits and other financial results is that there is a wealth of information available. Most corporations with annual sales of over ten million dollars publish annual reports. Also, companies whose stock is regularly traded on stock exchanges, either listed or over-the-counter, will be listed in financial services such as *Moody's*. Also, a variety of industry studies showing financial results are available in published form. This means that, if the results of other companies can provide any basis for judging your own results, there are few barriers to obtaining at least general information.

A practice we have found useful is that of picking out a reasonable number of companies—some of them in our own industry—and developing a rather complete comparative analysis of their growth and earnings trends every year. By keeping this study going year after year, we develop a history which gives us an opportunity to see the kind of growth and earning power that is possible, by individual companies. Such a study as this, though it is no substitute for the more precise broad averages available from government or private statistical sources, does give us a better idea of what some of the individual variations are. The fortunes of individual companies can change considerably in twenty to thirty years.

However, as in other parts of this paper, our purpose is not to discuss the whole subject of economics, accounting, and financial analysis but rather to outline some of the principal comparisons that can be useful as integral parts of regular management reports. This means that we must focus attention on key results and that we must use yardsticks which can be easily obtained. More elaborate and refined studies will, of necessity, be required for complex decisions involving choices between alternative courses of action. The kind of analytical work done inside companies when a major investment decision is involved—or the kind of work done by outside security analysts—are both examples of this. For regular reporting purposes, simpler measures can be used, but they often point out the need for further study in a particular direction.

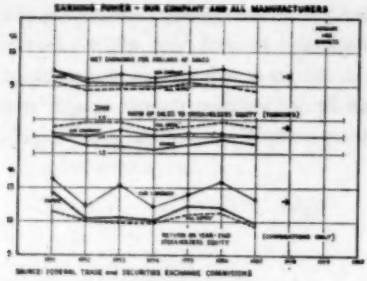

**EXHIBIT 7**

TRENDS IN SALES, EARNINGS, DIVIDENDS

| Industry and Year | Per Cent Change From Previous Year Sales | Net Earnings (after taxes) | Dividends | Per Cent of Earnings Paid in Dividends |
|---|---|---|---|---|
| **ALL MANUFACTURERS** | | | | |
| 1951 | - | - | - | 47.4 |
| 1952 | + 17.6 | - 6.2 | + 1.8 | 51.4 |
| 1953 | + 6.3 | + 5.6 | + 1.8 | 48.6 |
| 1954 | - 6.6 | - 0.9 | + 5.4 | 52.7 |
| 1955 | + 12.0 | + 24.8 | + 15.3 | 45.0 |
| 1956 | + 11.3 | + 7.3 | + 8.8 | 48.7 |
| 1957 | + 10.3 | - 3.7 | + 2.7 | 48.7 |
| **PAPER and ALLIED PRODUCTS** | | | | |
| 1951 | - | - | - | 38.7 |
| 1952 | + 3.8 | - 3.8 | - 2.0 | 45.4 |
| 1953 | + 0.1 | + 2.3 | + 2.6 | 44.4 |
| 1954 | + 1.1 | + 6.7 | + 13.0 | 47.9 |
| 1955 | + 15.3 | + 25.0 | + 13.0 | 43.3 |
| 1956 | + 9.2 | + 10.9 | - 2.5 | 37.9 |
| 1957 | - 2.5 | - 0.2 | + 4.0 | 48.1 |
| **OUR COMPANY** | | | | |
| 1951 | - | - | - | 40.0 |
| 1952 | + 2.2 | - 8.2 | + 6.8 | 47.0 |
| 1953 | + 8.6 | + 30.3 | + 14.9 | 42.0 |
| 1954 | + 6.5 | - 4.7 | 0.0 | 44.0 |
| 1955 | + 7.7 | + 26.8 | + 14.8 | 40.0 |
| 1956 | + 5.1 | + 15.4 | + 29.4 | 41.0 |
| 1957 | + 0.2 | - 15.0 | + 12.5 | 35.0 |

* Corporations only. Federal Trade and Securities and Exchange Commissions.

**EXHIBIT 8**

Two illustrations involving yardsticks for earning power will be given. The first is a graph, shown as Exhibit 7, which compares our company results with those of all manufacturing corporations and of corporations in the paper and allied products industry. The ratios which are used are (1) the per cent of net profit after taxes earned on the sales dollars, (2) the turnover of the stockholders equity, and (3) the per cent of net profit earned on the stockholders equity. These are three of the most commonly used financial measures and our intention is to use them here in as simple and direct manner as possible. The outside comparisons are taken directly from the *Quarterly Financial Report for Manufacturing Corporations* published jointly by the Federal Trade Commission and the Securities and Exchange Commission. Quarterly figures have been added to give annual results and the year-end book figures have been used for stockholders equity in computing return on investment.

In companies which have developed internal measures of return on investment, outside ratios such as these will probably not fit internal results because of differences in classification or valuation. This usually is because desired refinements have been introduced in the internal study to make comparisons, such as between operating divisions, more meaningful. We have this problem in our own company but have not found it an obstacle to using the cruder outside measures as yardsticks for judging our over-all results. In most instances the broad measures will move in the same direction as the more refined ones, even though they are not so accurate.

The final illustration, given in Exhibit 8, is a comparison of trends in sales, earnings, dividends, and the proportion of earnings paid out in dividends. The

purpose of this presentation is to indicate to management the general relationship of its dividend policy to that of industry as a whole. In recent years, this has become a very important matter, because the impact of inflation upon financial figures has made it difficult to use our individual financial histories as guides to current financial policies. Lower ratios of dividends to earnings has been one aspect of this but now, with much of the post-war expansion behind us, the proportion of dividends to earnings may tend to increase. This type of supplementary information, when used in conjunction with the comparisons that have been illustrated in this paper, tends to make the presentation more useful for managerial purposes.

### *Need for and Availability of Economic Yardsticks*

It has been the purpose of this paper to illustrate and discuss briefly some of the ways in which economic yardsticks or comparisons can be used in accounting reports. The need for these comparisons stems from the growing belief by business managers that they can better judge the results of their companies' operations if these results are put into perspective. Carefully chosen yardsticks can help to provide this needed perspective. For a yardstick to be an ideal one, several conditions must be met. However, if it meets only a few of these conditions, it can still be workable and serve as a stepping-stone to a better one. Some of the most important of these conditions are ease of availability, consistency in basis and timing with the company figures with which it is used, and that it be descriptive, in that the yardstick be representative of performance with which we should compare our own results.

The examples which were given dealt with long-run growth, current market performance, factory performance and costs, and earning power. Beyond these, there are other aspects of company operations to which yardsticks can also be applied, such as capital expenditures, research spending, debt structure, and many others. The illustrations given, however, were suggested as ones primarily for regular use with management reports and not as substitutes for more detailed and intensive comparisons that may be necessary for special studies. One of the principal rewards which come from using yardsticks such as these in management reports is that the several members of management tend to develop a common ground of understanding about the significance of the results of their company's operations.

## CHALLENGES IN THE FACILITATION OF RESEARCH

by Rayford W. Harwell*

INDUSTRIAL RESEARCH is the most difficult of all business operations to measure and control. Few executives trained in accounting, for example, can understand the details of scientific work. At the same time, the scientist competent to deal with such concepts fits into few of the normal, recognized patterns of corporate organization. Thus the critical problem has assumed, for management, two aspects: communication and control. It is usually necessary for top management to learn to understand the significance of the company's research—the new fields it opens up and the new products it makes possible. The scientists, on the other hand, must have some sensible notion of what kinds of products and ideas the company is able to exploit commercially.

Efforts to solve this problem have produced the newest executive specialist on the management level. He is the research director, sometimes referred to as the research administrator. However, research cannot be integrated into a company simply by putting a scientist on the board of directors or appointing a scientist as research director. The research director, in addition to being a competent scientist, has to be a qualified administrator, informed of company policies and firmly grounded in economics and industrial technology. The promotion of the scientist to executive authority can generate new problems. Usually, the higher a research director rises in his specialty, the less direct contact he has with science. To do his job intelligently, the research director clearly has to be conversant with all of management's problems. Not only should he determine that a new product is technically possible, but he must find out how much it will cost to make, how big the market is likely to be, and he must have an explicit understanding of his company's plans for the future.

While the research director has to become something of a business strategist and cost accountant, he still avoids most of the details of office management. In most companies, these details fall to another key man, the administrative assistant. He prepares the budgets, authorizes minor expenditures, "bosses" clerical workers and generally sees to it that scientists are relieved of administrative paperwork but are kept fully informed so they will have nothing to worry about but their research. This arrangement works well when a research department is small but, when it expands,

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the lines of communication get longer and personal interpretations of findings or objectives become impractical. A finding passed through many echelons can lose so much in the interpretation that management is unable to see its implications. Usually, scientists who think and talk among themselves primarily in a mathematical language cannot express their ideas on paper in a way laymen understand and, if separated from other sections of the plant, can often fail to appreciate what a discovery means in terms of a company's capabilities.

The communications problem in research has prompted considerable analysis of organization theory and structure. Some companies believe that research is more effective and researchers are less dissatisfied when they are organized on a project basis around their particular talents, rather than on a functional basis like the rest of the company. The assignment of specific projects, however, brings its own peculiar problems. A scientist who will eagerly go to work on an idea of his own may not generate enough enthusiasm on another person's idea. It is widely assumed that scientists are basically different from all other groups in industry and that they require special treatment. This has raised a question in management circles. Should research be governed by traditional management policy or range freely into new fields? At all events there are many individuals in a company, working in applied fields, who may have had research training in scientific or engineering activities and would like to have some time to pursue research problems beyond the limits desired according to immediate engineering standards. The following paragraph outlines a procedure recommended for the stimulation of individual scientific research.

The individual scientist can submit his research proposals by means of the Request for Scientific Research form (Exhibit 1). The completed form is forwarded to the department head for approval. The department head will forward the form to the director of scientific research, who can authorize the project and provide funds via a work order, if the proposal is suitable. The individual initiating the proposal will then do the research work, reporting to his usual supervisor, but under the technical direction of the director of scientific research for the term of his project. However, in the administration of this procedure, the individual cannot be left to pursue—at any cost—every whim of investigation without regard to profit-making end products. There must be a type of control which is effective, at least in terms of communications.

E. Guy Melanson's article, "Controlling Research and Development Expenditures to Profitability" in the August 1957 issue of the *Bulletin* is based on the principle that budgets

**REQUEST FOR SCIENTIFIC RESEARCH**

TITLE _____

RESEARCH DESCRIPTION: On this page and any additional pages needed describe briefly the nature of the research for which supporting funds are desired. Include an estimate of number of manhours and laboratory equipment required if research is to be done in the plant. Recommend a research organization if work is to be done outside. Include a problem statement and a proposed method of attack. Submit 3 copies.

**ESTIMATE COST AND SCHEDULE**

Man Hours _____ @ $ _____ per hour = $ _____
_____ Hours _____ @ $ _____ per hour = $ _____
_____ Hours _____ @ $ _____ per hour = $ _____
Material _____ $ _____
Total _____ $ _____

Estimated Start Date _____
Estimated Completion Date _____
Recommended Reporting Interval _____

Prepared by: _____
Location: _____
Phone: _____

**APPROVALS**

_____ Department Head _____ Date _____ Director of Scientific Research _____ Date

**EXHIBIT 1**

often become the most effective means of communications, from top management down, of what is expected of all members of the team. The preparation of the annual budget for research and development should utilize the combined planning efforts of the research director working closely with sales, production, market research and the controller to provide the best program practicable. Just pouring out more money for research and development does not assure success if the quantities and qualities of men and machines are not available and there is no long-range plan of work coupled with sound financial control through budgets.

In the defense industries, new weapons such as supersonic aircraft and missiles, with their emphasis on electronics, have placed a heavy burden on technology and the demands for a well-balanced research and development program.

Although this nation leads the world in productive capacity and has the proven ability to exploit that capacity for defense purposes, it does not hold an equivalent lead in the field of new ideas. It is important, therefore, that each industry establish within its own organization a climate which will encourage to the fullest extent, all available creative talent in the fields of science and technology. It is imperative that the accountant contribute to this common purpose and add to his wealth of financial and business management knowledge, an understanding of the communications problems in research.

# Budgeting for Research and Development in a Manufacturing Division

by S. STUART BRUCE

RESEARCH AND DEVELOPMENT expenditures form a major element of cost which is controlled largely by management decision as to their contribution to the overall long-term benefit to the company. They are not necessarily governed by current operating requirements or business volume but can be expanded or contracted as management sees fit. The budgetary procedure about to be examined is intended to provide a uniform control and accounting system for research and development expenditures which will:

1. Facilitate the formation of management decision by whatever means of objective evaluation as is available.
2. Provide comparable cost data to assist in establishing company policy by comparisons between divisions and with other companies.
3. Provide an authorization and reporting procedure which ensures conformance to company policy as expressed in an annual budget or appropriation.

Research and development activities at Eastman Kodak Company are carried on in a central research laboratory as well as by the various manufacturing divisions. Although many of the principles involved in this procedure are applicable, to a large extent, wherever research and development is being carried out, this procedure is still under development and in use by only one of the manufacturing divisions of the company.

## *Research and Development — And Its Purposes*

Before beginning the discussion of the problems involved in budgeting for research and development expenditures and how the procedure dealt with here attempts to meet the needs, it probably would be wise to establish some basic ground rules or definitions. For example,

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1. What do we mean by research and development under this procedure?
2. What are the purposes of research and development?
3. Under this procedure, what kinds of activity contribute to the research and development program?

For the manufacturing division with specific products and profit objectives by which this procedure is used, our definition of research and development restricts activity to work in the fields of the physical sciences, biological sciences, and related engineering when the purpose of the work is one of several. It may be to pursue a planned search for new knowledge pertaining to the industry, whether or not the search has reference to a specific application. Or it may create a new product or improve an existing product, including the technical work necessary to evaluate and promote its use to the point of acceptance by the sales department and the trade. Or else the objective may be to invent a new or improved process or machinery to make a finished product or component.

Let us examine some of the more important reasons for research and development activity. The first is to protect the sales dollar, that is, to meet competition. In this category are the programs having to do with improving the quality or performance of products. It may be engaged in to achieve cost savings in either operating or capital expenditures. It is possible to do research to promote new sales dollars, either by entering a new market not now enjoyed at all or by significantly expanding an existing market. There is also the type of research necessary just to gain knowledge, especially with regard to one's own industry and its problems. The last major purpose of research is general in nature, intended to cover any programs not involving cost savings, product quality or other factors regarding sales, but which covers problems with respect to safety, working conditions, etc. Ideas or evident needs for research and development programs may come from many sources both in or outside the company: customers, competition, sales division, management, research laboratory or manufacturing division.

### *The Boundaries of Research and Development*

In general and especially in connection with the procedures to be discussed here, a wide range of kinds of activities is considered to be research and development effort. They include laboratory scale, pilot plant, semi-works plant operations or full-scale plant operations to develop or improve a product or process

or to gather scientific data and knowledge pertaining to the industry, but not insofar as such operations are for the primary purpose of producing useable or saleable products or are for the purpose of testing or trouble-shooting on regular production operations. Any useable or saleable product obtained in the process of carrying on this activity is considered a by-product of the experimentation and the fair value credited to its cost.

Included also is the engineering activity and invention required to advance the design of the product or a process (including production equipment, tools, control instruments, testing equipment, safety devices, and equipment for carrying on experimental work) to the point that it can be turned over to production or construction units with the reasonable assurance that it will work. The invention, design, construction and testing of pre-production prototypes and models and the engineering follow-through in the early production or construction phase are also included in research and development, as is any excess cost incurred in the manufacture of newly-designed production equipment. (Excess cost is that which is above fair replacement value.) Likewise, research and development comprehends engineering and technical effort expended in production departments during the transition stage between development and production, to get a new or improved product or process working smoothly under normal operating conditions but not the trouble-shooting that may be required after normal operating conditions have been established.

The distinction between work for improvement of manufacturing standards, requiring research and development, and work for correcting below standard conditions is not always sharp and clear. This is because manufacturing difficulties may be the result of changes in the system arising from a research and development program. If so—if manufacturing difficulties are directly and immediately the result of changes emanating from research and development work—then the work required to correct such difficulties is properly a part of the latter. This is on the principle that the additional corrective effort is an inherent part or necessary extension of the project and is required for its successful implementation. On the other hand, work required to correct manufacturing difficulties is to be classified as manufacturing problems where the work cannot be identified as an integral part of a particular research project or the product or process was accepted by manufacturing tests as having operated within standards prior to the difficulty. The foregoing differentiation does not, of course, eliminate areas of confusion but it attempts to narrow the area by requiring a demonstrable and direct relationship without intervening satisfactory performance, between a change and subsequent corrective work before such corrective effort can be classified as research and development. All other

trouble-shooting work will be considered to be manufacturing cost and classified as manufacturing problems.

The development of new or improved testing methods and equipment should be included in research and development but not routine tests or pilot runs on new batches of materials or tools when such tests are in connection with established product or process. Nevertheless, tests of this sort, in connection with an experiment chargeable to research and development shall be included. Further, non-technical effort essential to these technical activities is includible and covers direct operators on machines producing experimental product, instrument makers and draftsmen working on experimental models, and other direct services to technical personnel engaged in research and development work.

Verging toward the sales side, research and development takes in engineering or technical assistance to the sales service organizations in initially evaluating or promoting the use of a new or improved product by the trade to the point of acceptance by the sales department as an established product. The cost of such effort would be included in the program developing the new or improved product itself. Also allowed in is work in connection with customer installations, where the objective is to evaluate new or improved company products or processes under trade conditions. Work undertaken to modify an existing company product for the benefit of a particular customer where the modification is not expected to result in a new company product would not be considered as research and development. "Customer survey" work, where the purpose is to maintain a check on the performance of existing company products under actual trade conditions, would be considered as manufacturing cost on the basis that such work represents an extension of quality control, undertaken to make sure that company products and processes perform satisfactorily in the trade and that plant quality control tests are adequate to produce useable product.

### *The Interest of Management, Research Staff and Accountants*

Management, both plant and company, has a very real concern with the problem here considered. It is acutely aware of the increased necessity for and rapid growth of research and development activity in recent years. Management must also keep in mind that the capacity of technical and scientific effort available within manufacturing organizations to carry on this activity is not something which can be built up over night except at what probably would be prohibitive cost. By the same token, it would seem reasonable that it would be difficult, if not painful, to reduce this capacity very quickly. Management's decisions as to the expenditure of research and development effort, therefore,

must necessarily be two-fold—both long and short-range. From the long-range point of view, management must assure itself that the general trend of the program is in line with future market trends and demands and that the future cost of the program is not at odds with forecast economic and financial conditions. From the short-range point of view, management must ascertain that experimental effort is currently being expended on programs which give the greatest margin of return on the research and development dollar invested or ensure maintenance of gains already made through prior development.

The research and development staff, that is, the various technical people in the manufacturing division responsible for carrying on the activities, are also very much involved in the problem of budgeting for this function. They are faced with the problem of presenting their ideas to management along with the data required to properly evaluate the worth of these ideas, so that a proper decision can be made as to what programs should be pursued and at what pace.

The accounting department, as a staff organization to various levels of supervision and management, is faced with the problem of helping in the presentation of a budget picture with clearly defined goals which can be evaluated, as well as some of the data necessary for proper evaluation.

### *Functional Classification and Evaluation of Research and Development*

The research and development project is in direct competition with other projects, such as capital investment, for monies available. It is, therefore, of extreme importance that the budget picture presented to management show not only "how much" and "for what" but "why". The worth of the research and development program must be shown as clearly as possible, so that it can be compared with similar programs and also other investment possibilities. In order to present an appropriation request for research and development expenditures to management, which permits recognition of the various goals of the activity, along with sufficient data to permit proper evaluation, it becomes necessary to classify experimental activities as to their motivation or intent. Several classifications have been established, each of which has some common criteria for the purposes of evaluation. The principal ones are:

1. Basic investigation
2. New product development
3. Product improvement
4. Cost and/or capacity improvement
5. Safety, health and convenience

Let us take these categories and define the type of activity or program which would fall under each, along with the primary method of evaluation.

Basic investigation is experimental effort expended for the primary purpose of adding to the overall scientific knowledge of the division without specific commercial objectives. The application of such knowldege in the solution of a specific problem related to product or process would not be included under this classification. Because of the difficulty of objective evaluation, experimental effort in this category is judged largely on the basis of the relationship of its cost to total research and development expenditures, as well as the value of past contributions resulting from the expenditure of similar effort.

New product development is experimental effort required to develop an entirely new product. If a current product is replaced, there should be a major change in function or use which the new product fulfills, resulting in a major effect on the market. If, in the case of replacement of a current product, these conditions are not met, the effort is classified as product improvement. Experimental effort in this category should be judged on the relationship of the cost involved (both research and development and implemental capital) to estimated future sales and profitability of the product.

Product improvement is experimental effort required to improve existing finished products offered to the trade, in order to maintain the company's competitive position. Such improvement is concerned mainly with quality and/or performance without creating a significant change in function or market or resulting in a substantial savings in manufacturing costs:

1. Even if the experimentation results in major technological changes in a product, which produce a substantially new product, the effort would be considered to be product improvement unless a significantly new function is served or new sales dollars attracted.
2. Development work undertaken to improve a product at interim stages of manufacture would be considered as product improvement only if it was expected to result in an improvement of the finished product to the trade. Where improvements are sought at interim stages of manufacture to permit or facilitate process changes in the manufacturing cycle in order to improve cost or capacity characteristics, the development work would be classified as cost and/or capacity improvement.

Evaluation of product improvement cannot be completely objective. However, the following factors should be considered:

1. Relationship of research and development costs to sales and profitability of the product or products affected.
2. Position of product in market, in general and with regard to current quality and/or performance.

3. Relationship of research and development costs to expected achievement.
4. Company prestige and its worth.

Cost and/or capacity improvement is experimental effort required to develop a new process or type of manufacturing equipment or to improve a process or process equipment in order to reduce operating cost and/or increase capacity. If a new or improved process is sought for the primary purpose of improving quality, the effort should be classified under product improvement. If a new or improved process or equipment is being developed in conjunction with the development of a new product, the effort should be classified under new product development. Evaluation of effort in this category will be judged on the basis of prospective cost savings and/or avoidance of capital expenditures, as compared to the cost of research and development plus implemental capital required to achieve the gain.

Safety, health and convenience embraces experimental effort required to keep manufacturing conditions within the requirements of company policy with regard to these considerations. This classification should be used only when these factors are not covered in a program developing a new or improved process or machine. Again it is difficult to evaluate the goals of activity in this category objectively. However, several factors, such as employee welfare and relationships, company prestige, contributions to the community, etc., might be considered in examining the worth of the activity.

### *Identification and Justification of Project Activity*

Beyond the classifications described above, research and development effort is further classified and identified by programs, each having a goal which can be recognized and evaluated by whatever means is used for those within the particular classification. The individual jobs to be done or the various phases through which experimentation must pass in arriving at the goal of the program are further identified by some means, such as an experimental work order. This final breakdown normally will represent the smallest unit of effort by which the person responsible wants to control. This system of classifying and identifying research and development effort gives us three levels of activity:

1. The major classification identifies and collects all research and development effort pointed in a particular direction, e.g., new product development.
2. The program identifies the effort required to reach a particular goal within the major classification.
3. The experimental work order identifies a specific job to be done in order to reach the goal of the program.

For purposes of illustration, let us assume an organizational structure such

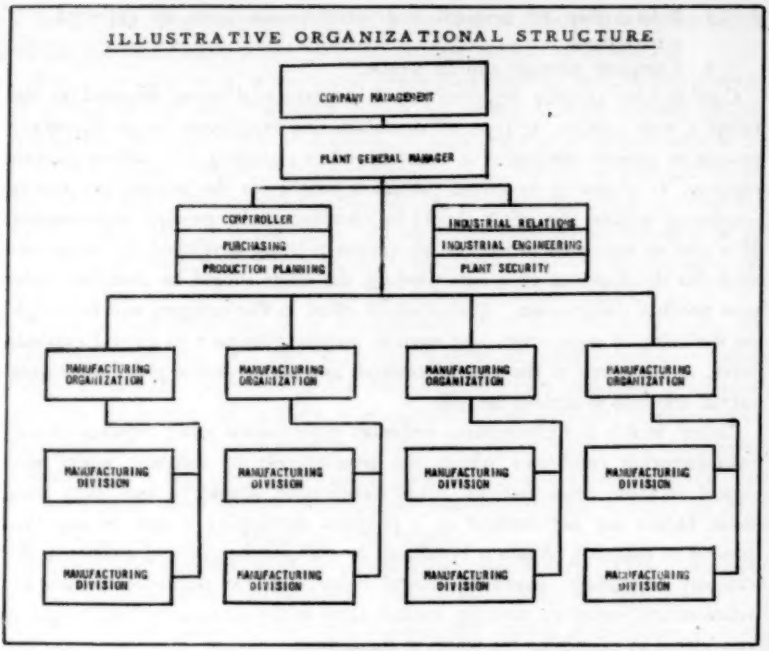


**EXHIBIT 1**

APPROPRIATION REQUEST — RESEARCH AND DEVELOPMENT PROGRAM
( Alternative A )

| | |
|---|---|
| PROGRAM TITLE | AMOUNT REQUESTED FOR 1958 $ |
| | EXPENDITURES PRIOR TO 1958 $ |
| PROGRAM NO. \| MAJOR CLASS. { } NEW PRODUCT DEVELOPMENT { } COST AND/OR CAPACITY IMPROVEMENT | ESTIMATED EXPENDITURES AFTER 1958 $ |
| REQUESTING DIVISION | TOTAL ESTIMATED COST OF PROGRAM $ |
| DESCRIPTION OF PROGRAM (INCLUDE JUSTIFICATION AND/OR EXPECTED RESULTS) | CAPITAL EXPENDITURES REQUIRED IF EXPERIMENTAL ITEM IS SUCCESSFUL $ |

(Alternative B)

| | |
|---|---|
| PROGRAM TITLE | AMOUNT REQUESTED FOR 1958 $ |
| | AVERAGE ANNUAL EXPENDITURES FOR LAST 5 YEARS $ |
| PROGRAM NO. \| MAJOR CLASS, ( ) BASIC INVESTIGATION ( ) PRODUCT IMPROVEMENT ( ) SAFETY, HEALTH, CONVENIENCE | CAPITAL EXPENDITURES REQUIRED IF EXPERIMENTAL ITEM IS SUCCESSFUL $ |
| REQUESTING DIVISION | |
| DESCRIPTION OF PROGRAM (INCLUDE JUSTIFICATION AND/OR EXPECTED RESULTS) | |

**EXHIBIT 2**

as that shown in Exhibit 1. Prior to the beginning of the fiscal year, the various divisions submit to plant management their requests for research and development program appropriations for the ensuing year. These requests are made at the program level, using one of the two forms shown (in part) in Exhibit 2. All spaces, with the exception of program number, should be filled

QUESTIONNAIRE FOR DATA REQUIRED FOR EVALUATION OF

RESEARCH AND DEVELOPMENT PROGRAMS,

GENERAL QUESTIONS

(To be considered on any Program)

1. What is the total estimated experimental cost?
   This year? Total for program?
2. What are the total estimated capital expenditures required to take advantage of successful completion of the program?
3. Is this program in connection with proposed capital expenditures or to prevent future capital expenditures?
4. How urgent is the need for this program? Discuss deadlines involved.
5. What are the probabilities of successful completion? By what date? Will this permit meeting deadlines?
6. What foreseeable problems must be solved for which E. W. O.'s might be requested?
7. Will the results of this program benefit other programs?
8. What other divisions or groups are working on this program?
9. Are there possibilities of duplication of effort? If so, is this unavoidable?
10. Do we have adequate facilities and effort available for the experimentation required? If not, what would be needed and at what cost? When would they be available?
11. On programs of a continuing nature (basic investigation, product improvement).
    a. What useful results have come from this program during the past year?
       (or in previous years if such information would be helpful for evaluation)
    b. Indicate any changes in direction of effort planned for the next year.
    c. Is the effort based on the talents of one or more individuals?
    d. Would the work be changed if these talents were not available?

QUESTIONS UNDER SPECIFIC MAJOR CLASSIFICATIONS

Fundamental Research and Basic Investigation

1. Description of field or direction of research and expected results.

New Product Development

1. Description of the product including functions or uses.
2. Who originated the idea for the product?
3. If a current product is replaced by the new product, how does the new product differ:
   a. Technologically. b. Functions or use. c. Effect on market.
4. What are current annual sales of the old product? Volume and/or dollar value.
5. What are the prospective annual sales of the new product? Volume and/or dollar value.
6. Is there a competitive product on the market now?

Product Improvement

1. What product will be improved?
2. How is the product used?
3. What characteristics or properties are in need of improvement?
4. Why is there a need for improvement? To maintain competitive position, to catch up with competition, to expand the market?
5. What are current annual sales? Volume and/or dollar value.
6. What will the effect on operating cost be? (Both increases or decreases)

New or Improved Process Development

1. Description of the process or equipment and its purpose.
2. How does it differ from the process it replaces, if such is the case?
3. What savings will result from successful completion? Discuss probabilities and possibilities.
4. How will savings be effected? Capacity, labor, material, waste, other. Discuss savings in detail.
5. Will this work also have an effect on quality? Describe.

Safety, Health, Convenience

1. Description of the nature of the program, showing expected results or conditions, including degree where possible.

**EXHIBIT 3**

LISTING OF PROPOSED RESEARCH AND DEVELOPMENT PROGRAMS FOR 1958

**Basic Investigation (In $ Thousands)**

| Program Number | Program Title | Average Annual Expenditures 1955-6-7 | 1958 Appropriation Request | Superintendent(s) Responsible |
|---|---|---|---|---|
| 101 | (Short ) | $ 230 | $ 248 | Jones |
| 102 | (Descriptive) | 48 | 76 | Brown |
| 103 | (Title ) | 97 | 80 | Brown (45, Smith (35) |
| 104 | | 11 | 14 | Edwards |
| 105 | | 39 | 47 | Edwards (30), Jones (17) |
| Total Basic Investigation | | $ 430 | $ 465 | |

NOTE: In the complete list, PRODUCT IMPROVEMENT and SAFETY & HEALTH program lists are in similar form to BASIC INVESTIGATION;

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COST AND/OR CAPACITY IMPROVEMENT are in similar form to NEW PRODUCT DEVELOPMENT but also show % return on total expenditures.

**New Product Development (In $ Thousands)**

| Program Number | Program Title | EXPENDITURES 1958 Appropriation Request | EXPENDITURES Prior to 1958 | EXPENDITURES After 1958 | EXPENDITURES Total for Program | Capital Expenditures if Successful | Prospective Annual Sales 2 to 3 Years After Introduction | Superintendent(s) Responsible |
|---|---|---|---|---|---|---|---|---|
| 201 | (Title normally includes name ) | $ 103 | $ 35 | $ 20 | $ 158 | $ 500 | $ 3,000 | Richards (65), Smith (38) |
| 202 | (by which New ) | 15 | 17 | - | 32 | - | 600 | Smith |
| 203 | (Product will ) | 5 | 33 | 10 | 48 | 50 | 750 | Smith |
| 204 | (be known. ) | 40 | 406 | - | 446 | 150 | 2,500 | Edwards (17), Fisher (23) |
| 205 | | 50 | 112 | 50 | 212 | 100 | 250 | Connelly (37), Fisher (13) |
| Total New Product Development | | $ 213 | $ 603 | $ 80 | $ 896 | $ 800 | $ 7,100 | |

EXHIBIT 4

in by the requesting division, with particular attention given to the program description. It is within the description that the facts required to justify the program are found. The description should be written in narrative form. A Questionnaire for Data Required for Evaluation of Research and Development Programs (Exhibit 3) can be used as a check-list illustrating the type of information to be included in a program description. The items shown need not all be referred to on every program nor should this list be considered as exhaustive. Information on cost figures and the like might be required from sources outside the requesting division and, in such cases, the accounting department or other organization should be consulted. Although programs are classified according to their major or primary intent, it must be kept in mind that many programs have secondary justifications. These should also be discussed in the program description. In all cases, the description of a program should be tested with this question: "Can management understand the intent of and evaluate this program on the basis of the facts presented?"

The annual program appropriation requests are submitted by the manufacturing divisions to the manufacturing organization manager for his approval. If the manager concurs with the desirability of the programs, they are then forwarded to the general manager. Now follows the task of putting together the annual appropriation request for research and development as a whole. This is done at the program level and all effort, regardless of manufacturing divisions or manufacturing organizations, is accumulated under common programs. These are identified by code numbers, the first digit indicating the major classification under which the program falls. For example, the 100 series might cover basic investigation programs, the 200 series, new product development, etc. In addition to the listing of proposed research and development programs (Exhibit 4), further summary analyses (Exhibit 5) are prepared. One portion accumulates total research and development effort by manufacturing organization (upper half) while another accumulates total effort by major classification (lower half), so that management can see how much effort is pointed in various directions. The proposed expenditures under the product improvement classification are analyzed by major family of products so that comparisons can be made with the respective sales of these products. For the cost and/or capacity improvement classification, the per cent return on expenditures, both research and development and capital, is calculated for individual programs and summarized by manufacturing organization. Charts are also included in the annual appropriation request so as to indicate the various trends of spending.

Not only will programs be submitted at the beginning of the year as part of the annual appropriation request but new programs will arise from time to

time. To provide for this situation, an unassigned provision for new programs is added to the overall appropriation. Program requests can be submitted at any time during the year, therefore, and funds allocated from the unassigned provision for new programs to cover them.

When a division is ready to begin work on a particular job or phase of a program, an Experimental Work Order Request is submitted on the form shown as Exhibit 6. Since the program appropriation has already been approved for the division, the only reason for submitting a request is so that the general manager can assure himself that the job to be done is within the scope of the

SUMMARY ANALYSES BY MANUFACTURING ORGANIZATION
(In $ Thousands)

| | 1957 Estimated Expenditures | | 1958 Appropriation Request | | Increase* or Decrease 1958 Appropriation Over 1957 Est'd Expenditures | |
|---|---|---|---|---|---|---|
| | Amount | % of Total | Amount | % of Total | Amount | % |
| Division 1A | $ 648 | 16 | $ 701 | 15 | $ 53* | 8.2* |
| Division 1B | 318 | 8 | 344 | 8 | 26* | 8.2* |
| | $ 966 | 24 | $1,045 | 23 | 79* | 8.2* |
| Division 4A | $ 228 | 6 | $ 268 | 6 | $ 40* | 17.5* |
| Division 4B | 239 | 6 | 317 | 7 | 78* | 32.6* |
| | 467 | 12 | 585 | 13 | 118* | 25.3* |
| | $3,929 | 99 | $4,532 | 98 | $603* | 15.3* |
| Unassigned Provision for New Programs | 27 | 1 | 100 | 2 | 73* | |
| Total Research and Devel. | $3,956 | 100 | $4,632 | 100 | $676* | 17.1* |
| **Analysis By Intent of Effort (In $ Thousands)** | | | | | | |
| Basic Investigation | $ 356 | 9 | $ 465 | 10 | $109* | 30.6* |
| New Product Development | 198 | 5 | 213 | 5 | 15* | 7.7* |
| Product Improvement | 2,460 | 62 | 3,073 | 66 | 613* | 24.9* |
| Cost and/or Capacity Impr. | 836 | 21 | 676 | 15 | 160 | 19.1 |
| Safety, Health and Conven. | 79 | 2 | 105 | 2 | 26* | 32.9* |
| | $3,929 | 99 | $4,532 | 98 | $603* | 15.3* |
| Unassigned Provision for New Programs | 27 | 1 | 100 | 2 | 73* | |
| Total Research and Devel. | $3,956 | 100 | $4,632 | 100 | $676* | 17.1* |

**EXHIBIT 5**

EXPERIMENTAL WORK ORDER REQUEST

E.W.O. TITLE

TOTAL AMOUNT OF THIS E.W.O. $

AMOUNT TO BE APPLIED IN _____ QUARTER $

REQUESTING DIVISION | PROGRAM NO. | E.W.O. NO. | PROGRAM APPROPRIATION $

COST DISTRIBUTION | A/C NO. | AMOUNT ALLOCATED INCL. THIS E.W.O. $

DESCRIPTION | BALANCE OF APPROPRIATION AFTER THIS ALLOCATION $

APPROVALS

SUPERINTENDENT | MANAGER | GENERAL MANAGER

**EXHIBIT 6**

overall program. Hence, the description need contain only sufficient information for him to do so. Company management has been assured that after its approval of the research and development appropriation at the program level, adequate control will be maintained to insure that the programs, as they are carried out, are within the limits as specified in the original program appropriation requests.

### *Reviewing and Reporting On Programs*

At the end of each of the first three quarters during the year, a listing of all appropriations at both the program level and the work order levels is submitted to each division superintendent so that he may review his annual appropriation in line with the manner in which experimental efforts have been spent and will be spent during the remainder of the year. Adjustments may be made to annual appropriations at the work order level without any explanation being offered, providing the total amount of the program is not changed by a significant amount, say $5,000 or more. This limitation may be placed at any level commensurate to a company's operations or policies. Where the net effect of changes at this level is reflected at the program level by a change of more than $5,000, plus or minus, it becomes necessary to re-examine the entire program and a new program appropriation request must be submitted for approval.

Following the quarterly review, year-to-date actual research and development expenditures are reported to company management, summarized by program, major classification of effort, and manufacturing organizations in much the same manner as the annual appropriation request. These reports will also show the effects of the quarterly reviews and, as was mentioned earlier, significant changes of $5,000 or more to individual programs are supported by new program requests. Should it become necessary to increase the total appropriation for research and development expenditures, the entire annual appropriation request must be re-submitted with up-to-date data for evaluation and justification. These quarterly reports should be accompanied by technical progress reports making company management aware of both accomplishments and goals yet to be achieved. In this way management can formulate some idea of the return it is getting on the research and development dollar invested.

# REPORTING DEPARTMENTAL COSTS OF RESEARCH PROJECTS

by D. B. Gauss, Jr.*

RECENT BULLETIN ARTICLES in the area of research and development costs prompt me to outline the method we use to report monthly project costs in our process research and development departments. These departments are concerned with the development and pilot production of the new chemical and fermentation processes which originate in the research laboratories of the Upjohn Company, one of the world's major producers of ethical pharmaceuticals, located at Kalamazoo, Michigan. We feel that we have devised a very practical approach to reporting research and development costs on specific projects within a department. The techniques should be readily adaptable to other firms which have organized research and development programs.

The basic report which is the subject of this discussion is put out by each department concerned. It is used by the departmental supervision as a guide to their research and development efforts and is also helpful as an aid in the preparation of future operating budgets. These reports are also summarized quarterly and distributed to divisional management, where they have been most useful in presenting the over-all cost picture of our process research and development efforts. The following "ground rules" were established as a guide in setting up the report:

1. Any additional paper-work should be done by the department, itself. This work and report preparation should require a minimum of time.
2. Approximate distribution of the total costs to the various projects would be satisfactory, but the major costs should be pinpointed as closely as possible.
3. The technical and operating personnel in the department should not be burdened with data keeping and/or recording to provide information for the report.

Although the total monthly expenses for each department were available from the general accounting department, the practicability of having the accounting department record the costs on the various projects was ruled out due to the number and constant changes of research and development projects within the departments. An examination showed that the major monthly direct expenses in the departments were salaries, supplies (including many expensive chemical intermediates and raw materials) and equipment repairs and alterations.

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The problem, then, was to distribute these and other expenses among projects as accurately as possible, with a minimum of effort.

The mechanics of distributing the costs was evolved as follows. Each research and development project is given a code number at its inception. Once a month, every member of the department turns in a Monthly Time Allocation card, (Exhibit 1) listing

MONTHLY TIME ALLOCATION

Name J. Doe Dept. 100 Month Jan. 1958

| Regular Time | | Overtime | | |
|---|---|---|---|---|
| Project | % of Time | Project | Hours | % of Time |
| 2100 | 30% | 2130 | 4 | 100% |
| 2120 | 20% | | | |
| 2137 | 40% | | | |
| 2140 | 10% | | | |
| Total | 100% | Total | 4 | 100% |

**EXHIBIT 1**

the approximate per cent of his time spent on each project during the month. From this data, we obtain the per cent of total manpower (regular and overtime) spent on each project during the month. This percentage is used as a basis for distributing the salary cost to each project. We could, of course, use the above data to obtain the actual payroll dollars assignable to each project. This has been done in the past, but we have found that, in the long-run, the difference this makes in the total project cost is not significant enough to warrant the additional work required. Other minor direct expenses, such as laundry, telephone, and telegraph, etc. are also distributed on the basis of total manpower.

Fixed expense (depreciation, floor space, taxes, etc.), personnel benefits (hospitalization, annuities, cafeteria, etc.), utilities (steam, electricity, water, etc.), and service departments (machine shop, purchasing, electricians, etc.) which are not considered to be under direct control of the department are classified as "combined expenses" and also distributed on the basis of the manpower assigned to the projects.

Supplies, which is the second largest single expense, is distributed on an actual basis. The procedure is that, for purchased materials, the project number is entered on the purchase requisition. When the material is invoiced, the invoice is routed to the department. There the cost of the material is entered against the appropriate project. Intra-company transfers of supplies are handled by entering the project number on the inter-departmental requisition. At the end of the month, the costed requisitions are forwarded from accounting to the department and the costs are entered against the various projects. Service requisitions for equipment and building repair and alteration expense and other miscellaneous charges are handled in the same manner as intra-company transfer of supplies.

With the above data and the summary of overall departmental monthly expenses, routinely published by the general accounting department, we are able to prepare the monthly report

MONTHLY DEPARTMENTAL PROJECT EXPENSE SUMMARY

| | Monthly | Basis of | EXPENSE DISTRIBUTION BY PROJECT | | | | | |
|---|---|---|---|---|---|---|---|---|
| Direct Expenses | Expense (1) | Distribution | 2110 | 2120 | 2125 | 2130 | 2137 | 2140 |
| Salaries | $20,000 | Manpower | $ 7,200 | $ 6,000 | $3,200 | $1,000 | $1,200 | $1,400 |
| Overtime | 1,300 | Manpower | 700 | -- | 400 | -- | 200 | -- |
| Supplies | 15,000 | Actual | 2,000 | 10,000 | 800 | 100 | 2,000 | 100 |
| Equipment repairs | 9,000 | Actual | 2,000 | 1,000 | 3,000 | 1,000 | 1,500 | 500 |
| Assay charges | 100 | Actual | 50 | -- | -- | -- | 50 | -- |
| Travel | 150 | | | | | | | |
| Laundry | 300 | Manpower | 180 | 170 | 110 | 40 | 50 | 50 |
| Telephone | 50 | | | | | | | |
| Miscellaneous | 100 | | | | | | | |
| Total Direct Expenses | $46,000 | | $12,130 | $17,170 | $7,510 | $2,140 | $5,000 | $2,050 |
| Combined Expenses | | | | | | | | |
| Fixed expense | $ 7,000 | | | | | | | |
| Personnel benefit | 5,000 | Manpower | 6,840 | 5,700 | 3,040 | 950 | 1,140 | 1,330 |
| Utilities | 3,000 | | | | | | | |
| Service Departments | 4,000 | | | | | | | |
| Total combined expenses | $19,000 | | $ 6,840 | $ 5,700 | $3,040 | $ 950 | $1,140 | $1,330 |
| Total project expense | $65,000 | | $18,970 | $22,870 | $10,550 | $3,090 | $6,140 | $3,380 |

(1) Figures available from general accounting

**EXHIBIT 2**

(Exhibit 2). The total effort required for its preparation is a little more than one man-day per month.

After studying the report, one may wonder if it would not be more expedient to prorate all the expenses on the basis of the per cent of total manpower assigned to the project. In our case, this would very definitely give a distorted picture of the costs of the various projects. This is because there are many projects which require a relatively small amount of manpower and equipment but use very expensive raw materials and chemical intermediates and may require numerous expensive assay determinations, etc. Another question that may be asked is, "How do you allocate the costs of the various departmental service functions, such as material handling and storage, office, etc.?" We have found that, by assigning these functions a particular project number and allocating costs to them in the same manner as to the other projects, we get valuable information on the cost of these functions. When the quarterly expense report is issued to management, the costs of these service groups are shown but are prorated (on the basis of manpower) to the research and development projects in the totals at the bottom of the report.

In summary, we feel that the report described gives us an adequate picture of the costs of each of the various research and development projects within our process research and development departments. A major advantage of the report is that it takes a minimum of time in preparation and is prepared by, and primarily for use within, the department concerned.

# Accounting for the Operation of Nuclear Reactors

by J. A. McFADDEN

With the passage of the Atomic Energy Act of 1954, participation in peacetime developments of atomic energy was encouraged by the Federal Government, and the McMahon Act, as modified, permits private ownership of nuclear facilities and private use of nuclear materials. This legislation immediately presented to American industry a vast new area of scientific exploration which could not fail to produce a heterogeneous array of new products, processes, techniques and related phenomena. Hence, the world finds itself on the threshold of the atomic era.

Leaving the military aspects of the use of nuclear energy to the statesmen of the world with the assurance that self preservation will be the greatest deterrent to any political power that may consider its use as a weapon of aggression, one can turn to the problems presented by the peaceful uses, be they industrial, social or scientific. It would appear that a large portion of the task confronts the businessman. It will be he who will employ the physicists, chemists, metallurgists and engineers and will determine, to a great degree, the manners in which this phenomena will be harnessed and the applications to which it can be most beneficially and profitably directed.

Much has been learned, even at this early date, of the chemical and physical reaction resulting from the splitting of the atom. In industrial, scientific and medical fields, radioisotopes, irradiation facilities provided by research reactors and commercial power generated by nuclear reactors are presently employed in many practical and important ways. The scientific complexities of this technology will begin to be understood and regimented with ever-increasing speed. What, however, are the general business management and, particularly, the accounting and financial problems that will be encountered? Certainly, industry faces many more problems of planning and control than were present just after the turn of the present century when the impetus of a major world

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conflict forced upon American industry mass production with its attendant problems. With respect to accounting techniques, to apply to these idiosyncrasies of the single business of operating nuclear reactors, the accountant stands at approximately the same point of time, relatively, as he did prior to the development of standard costing systems for presenting the results of mass production manufacturing.

### *The Reactor — Its Operation*

The nuclear reactor is the basic facility in which the phenomena of the nuclear chain reaction takes place. Stray neutrons are present in almost any type of atmosphere and, when such particles encounter a critical mass of heavy material, such as uranium, a type of explosion occurs (fission) which causes the single atom to split into three fragments, and to emit several fast neutrons. The neutrons, especially when slowed, are capable of producing the same type of reaction upon striking other uranium atoms. Exhibits 1 and 2 illustrate how, by the use of a moderator (water or similar substance), neutrons are slowed to produce a chain reaction. The energy liberated by nuclear explosions can be converted into heat and used to produce power, such as electric power. In addition, other useful particles, such as beta and gamma rays, and other radioactive atoms can be produced in the reactor.

These simple explanations are in no manner intended to imply that all reactors are the same in physical size or construction or in the purpose for which they are used. It is sufficient, however, for purposes of focusing attention on the accounting problems inherent in the operation of any nuclear reactor to state that, in order for the necessary "chain reaction" to take place, there

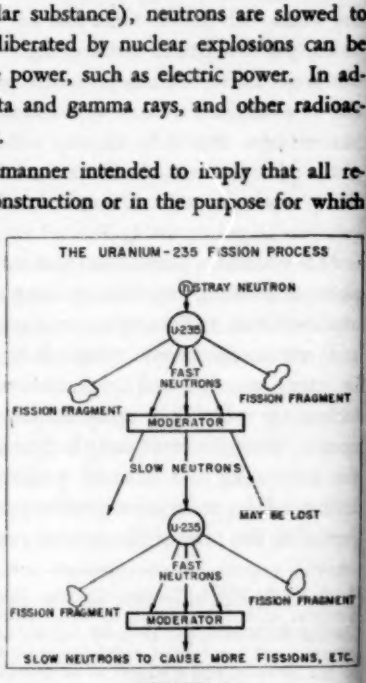


EXHIBIT 1

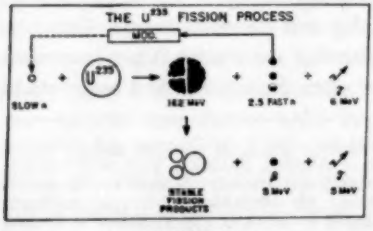


EXHIBIT 2

must be present in the reactor a minimum amount of fissionable material (fuel), usually uranium or thorium. This fuel (1) is extremely expensive, both for basic material rental and preparation costs, (2) must be handled at almost every stage with extreme care by trained specialists, (3) is subject to decay with respect to usefulness and financial value, (4) must be reprocessed and the residue returned to the supplier (Atomic Energy Commission) when its performance falls below certain operating tolerances, and (5) at every stage imposes grave financial and public welfare responsibilities upon the user. These minimum factors are at least present in the operation of any type of nuclear reactor, regardless of its power level or use for which it is operated. The problem only increases in order of magnitude between the small fractional megawatt power level reactor, producing neutron beams for the purpose of research studies, and the 1,000 megawatt reactor used as a heat source to produce electrical energy for a fair-sized city.

### *Basic Material Used in the Reactor*

The accounting for the cost of the basic material, or fuel elements, used in the nuclear reactor presents the greatest challenge because the relationship of effort contributed to operate the reactor facility, both in the direct and indirect categories, is closely allied, in evaluating the results of the reactor operation, to the fuel material life expectancy. Four elements of expense are, of course, easily identifiable in the accumulation of the fuel element costs. These are rent to the Atomic Energy Commission for basic material (less credits for scrap returned), fabrication and shipping fuel elements by processors, reprocessing of expended fuel elements by processors, and shipping of scrap to supplier (A.E.C.) The usage of fuel material, however, for any particular application, cannot be measured by conventional means due to the following factors:

1. The degree of radioactivity present renders the fuel elements unaproachable and, hence, the matter of actual physical inventory at any given point of time is not possible. Scientific estimates and measurements, at present, are further not accurate by a factor of approximately 10 per cent.
2. The quantity of neutrons produced in any given period throughout the reactor core by any segment of the fuel elements cannot be calculated nor determined accurately.
3. An approximate period of six months is required for processing the residual scrap after removal of the fuel elements from the reactor, to determine the residual value.
4. Operating hazards are of such magnitude that the first order of importance must be given to the most minute indication of dangerous

conditions. This usually results in excessive shut-down time, which materially shortens the productive life span of the fuel elements.

It would appear, therefore, that, in the absence of historical records based on actual experience, it becomes necessary to adopt standards which will provide reasonably accurate costing of the material usage factor in the reactor operation. Before considering the basis for establishing such standards, it is well to consider related cost elements.

### *What Are Labor or Salary Elements of Cost?*

In the considering of the labor or effort which must be applied to the operation of the nuclear reactor, it is well to segregate into two major categories the costs that arise from the constant operation of producing the results for which the reactor is intended and those required for overall technical guidance, radiological health requirements, and administrative control of the project of which the reactor is the principal facility.

It has been determined that the most efficient operation of a nuclear reactor is accomplished on a twenty-four-hour-per-day basis, even though the operation week can vary from five to seven days. This fact necessitates a three-shift operation, requiring such highly trained specialists as pile or reactor operators for each shift, with the addition of a basic staff of outstanding experts which must be present during the shift (usually the main day-shift) when major changes in the reactor operation are decided and effected. Accordingly, as a very minimum direct staff to operate even the lowest power level nuclear reactor on a practical basis for industrial purposes and to further assure that health and property contamination hazards are safeguarded, it is necessary to have approximately nineteen technically qualified people and one statistician or records clerk as shown below:

| | | *Shifts* | | |
|---|---|---|---|---|
| | *Totals* | *1st* | *2nd* | *3rd* |
| Chief nuclear physicist | 1 | 1 | — | — |
| Chief nuclear chemist | 1 | 1 | — | — |
| Radiological health officer | 1 | 1 | — | — |
| Health physicist | 3 | 1 | 1 | 1 |
| Radio chemist | 1 | 1 | — | — |
| Hot cell supervisor | 3 | 1 | 1 | 1 |
| Pile operator | 3 | 1 | 1 | 1 |
| Operating assistant | 3 | 1 | 1 | 1 |
| Technician (counting) | 3 | 1 | 1 | 1 |
| Recording clerk | 1 | 1 | — | — |
| | — | — | — | — |
| | 20 | 10 | 5 | 5 |

In the realistic pricing of the radioisotopes, irradiation time and space or commercial power provided by a reactor, it is necessary to consider the cost of the entire basic complement of personnel with respect to the output derived over the entire three-shift period. At the present stage of the art, it is not possible to weigh the contribution made by the nuclear specialists present during the first shift, so far as they may be related to the performance experience of any of the three operating shifts. All shut-down time might occur within a particular period (during the first shift), with the result that output in terms of performance, would be comparatively higher during the second and third shifts. However, the very fact that the reactor was "cooled off" or shut down on the first shift was all that made possible subsequent shift operation.

Accordingly, "effort applied" in the reactor operation does not necessarily assure a comparable relationship of "value added." Hence, in costing the output of a nuclear reactor, an hourly (or fraction thereof) rate, computed by dividing the toal salary cost of the operating personnel by the total hours scheduled as reactor operation time, should be established. Shut-down time should be accumulated and recorded for informational and technical guidance purposes but should not be used as a separate factor in determining the cost of products or services obtained from the reactor operation.

Whether the reactor facility is a separate, completely autonomous facility or whether it is a project which is part of a generalized plant facility having other operations which produce commerical results will determine the extent of the indirect and general administrative charges which must be considered in costing the reactor production. Regardless, however, of its organizational habitat, a minimum of indirect costs is related entirely to the reactor and its operation. It is vital that a reactor director, responsible for the entire operation, be appointed to coordinate the technical, social, and economic aspects of this endeavor. Related services, such as secretaries, librarians, maintenance mechanics, electronic engineers, storekeepers, janitors, and watchmen (security), are best utilized when assigned specifically to the reactor facility due to the unusual and specialized aspects of the daily servicing problems.

### *General and Administrative Expense, Especially Insurance*

Aside from the normal general and administrative expenses incurred in the operation of any organized endeavor, such as indicated in Exhibit 3, Classification of Accounts, there is present, with respect to the matter of nuclear energy, an extraordinary expense not existing to the same degree in any business enterprise or its undertakings prior to the discovery of the fission process of creat-

**ROENTGEN REACTOR LABORATORY—CLASSIFICATION OF ACCOUNTS**
**SECTION NUMBERS (Prefix to a/c Nos.)**

**Reactor Operation**

11 Nuclear physics
12 Radiological sciences
13 Nuclear chemistry

**Salaries and Wages:**

Indirect
101 Administrative
102 Clerical and stenographic
103 Guards
104 Janitors
105 Maintenance technicians
106 Storekeepers
107 Vacations, holidays etc. Lost time, etc.

Direct
151 Nuclear physicists
152 Nuclear chemists
153 Radiological scientists
154 Health physicists
155 Radio chemists
156 Hot cell physicists
157 Senior pile operators
158 Pile operators
159 Assistant pile operators
160 Technicians – General

**Reactor Services**

21 Maintenance - Facilities
22 Maintenance - Health, safety, and monitoring
23 Maintenance - Decontamination
24 Library

**Direct Materials and Other Expenses**

201 Source material - use charge
202 Fuel element fabrication
203 Fuel assembly burnup
204 Fuel assembly reprocessing
205 Residual scrap reclaimed (net credit)
206 Freight, express and cartage - Source material and fuel elements
207 Nuclear hazards insurance - third party liability
208 Nuclear hazards insurance - property damage
209 Nuclear hazards insurance - transportation floater
210 Special fuel handling

**Administrative Services**

31 Laboratory - Administrative
32 Accounts and finance
33 Personnel
34 Purchasing

**Other Operating Expenses**

301 Normal items of employees' fringe benefits, travel, light, to heat, power, common insurance, taxes, depreciation of
325 normal plant facilities, etc.
326 Maintenance of reactor
327 Containment or shielding water
328 Depreciation of reactor cores
329 Depreciation of monitoring equip.
330 Depreciation of specialized test equip.
331 Radioactive waste disposal

**Income**

401 Fees - Irradiation service
402 Sales - Radioactive materials
403 Sales - Radioactive isotopes
404 Other income and deductions

**EXHIBIT 3**

ing atomic energy. The matter of financial responsibility in the event of a nuclear incident or reactor spillover is a subject of much concern to American industry. Sections 170c. and d. of the Atomic Energy Act provide government indemnity to reactor operators in an amount of $500,000,000 and Section e. places the legal limit of liability on nuclear hazards at this amount.

For a reactor owner, or others employing nuclear energy for peaceful uses, to qualify for such indemnification, however, it is necessary that a certain amount of basic financial responsibility, determined by a rating of the facility by the

**REACTOR RATING FACTORS**

1. REACTOR TYPES -

Minimum to Maximum Rate
1. Minimum hazard – CP 5 Water tank
2. Boiling water – CWR
3. Sodium graphite and boiling metal
4. Heterogeneous breeders

2. USE FACTOR –

Minimum to Maximum Rate
1. Power reactor
2. Medical research - including therapy
3. Testing reactors - engineering materials
4. Industrial research
5. Educational research

3. SIZE OF REACTOR – HEAT OUTPUT NOT AMOUNT OF FUEL –

Minimum to Maximum Rate
1. 0 — 5
2. 5 — 35
3. 35 — 100
4. 100 – 300
5. Over 300

Megawatts of thermal heat generated in core

4. LOCATION OF REACTOR - POPULATION DENSITY, ETC.

Minimum to Maximum Rate
1. Isolated area – (Idaho)
2. Rural and sparsely populated
3. Rural but high value agriculturally
4. Industrial – urban
5. Residential – urban

5. CONTAINMENT –

Minimum to Maximum Rate
1. Fully contained – safety factor to resist maximum episode
2. Partially contained – on basis of engineering evaluation
3. Uncontained

6. UNUSUAL DESIGN CONSIDERATIONS –

Minimum to Maximum Rate
1. Engineering and Architectural
2. Engineering
3. Architectural
4. None

**EXHIBIT 4**

Atomic Energy Commission, be supplied from private sources. Depending upon a number of factors (Exhibit 4), the basic financial responsibility which must be provided from private sources varies appreciably and can reach such proportions that its assurance, or the cost thereof, might represent one of the major items of cost in the operation of a nuclear reactor. The insurance industry presently has provided, through stock insurance company pools, nuclear hazards coverage for both third party liability (Nuclear Energy Liability Insurance Association) and property damage (Nuclear Energy Property Insurance Association) with limits of $60,000,000 and $40,000,000, respectively. These limits include amounts provided by the Mutual Atomic Energy Liability Underwriters' pool and certain reinsurance from foreign markets.

In the case of both the stock and mutual insurance company pools, firm premium rate structures have not been promulgated and, while it is therefore possible for reactor owners, or others, to bind nuclear hazards insurance coverage up to limits offered by the joint pools, there is no definite assurance of the cost for such coverage. Proposed regulations of the Atomic Energy Commission provide that a minimum of $3,000,000 of third party liability insurance or other evidence of financial responsibility will be required by any reactor operator, and tentative rates for private insurance coverage develop a premium cost for this much coverage at approximately $20,000 on an annual basis. In addition, it appears that property damage coverage, including loss or damage to source material, will result in an additional $20,000 or more of expense annually.

It can easily be seen that the maximum coverage available, if required, could develop to sizable annual premiums. Considering, therefore, that private financial responsibility must be in evidence before government indemnification of nuclear hazards becomes operative, and with the present indication that the cost to insure such private financial responsibility will be a sizable element in the operating expense structure of a reactor facility, it is suggested that this cost factor be treated as a direct charge to the fuel cost instead of an item of direct overhead or general and administrative expense. There appears little difference between the relationship of this expense to the procurement of radioactive source materials than that which excise taxes, tariffs, royalties, and similar charges bear to the cost of other materials used in abundance by American industry.

Further, the coverage limits and cost of such insurance will fluctuate with the value and quantity of material on hand, in transit or in the custody of processors. Therefore, if the realistic costing of reactor output is to be accomplished, such protection, particularly if purchased, must not be considered in terms of the insurance contract span but rather in terms of the fuel usage

cycle. Accordingly, by relating insurance or other financial responsibility assurance costs to the source material and its usage, a refinement in costing will be accomplished which would not be present if this expense is grouped witth items generally associated with general and administrative expenses.

### *Bringing the Cost Elements Into a Costing System*

If the foregoing categorizes the various cost components present in the operation of a nuclear reactor, it appears logical, at this point, to consider the method by which the products, services, or information provided by the reactor usage is priced to assure full recovery of cost, regardless of the operating conditions which may be encountered. There is no doubt that many concepts of cost accounting will be applied to this problem and, as historical data is accumulated and experience gained in the operation of nuclear reactors, cost accounting techniques will be developed to a very sophisticated degree. For the present, however, it is necessary to face this problem with practically no experience or historical cost records.

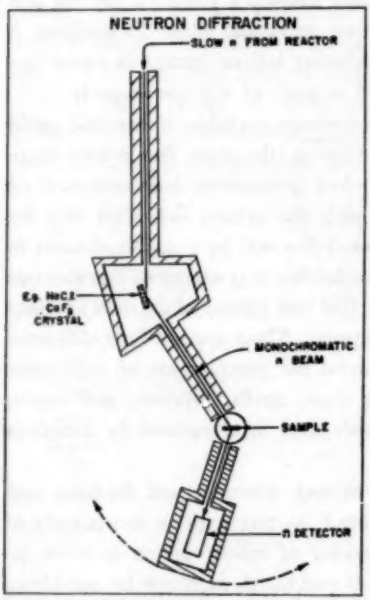


**EXHIBIT 5**

Three factors with respect to any reactor are, however, known or can be calculated or fixed by scheduling. They are core size or space available, maximum power level (megawatts), and operating time (hot pile). Hence, it is possible, by the application of the last two factors to develop the number of megawatt hours that the reactor will operate productively during the period of the fuel element life expectancy.

The consideration of core size or number of irradiation spaces available is important to permit costing of applications which require less than the entire core capacity in terms of space and thermal temperature. The total megawatt power level, multiplied by the number of core spaces or beam tubes, will produce the total megawatt hours of energy available for use

within the core. Assuming the reactor is used for the production of radioactive isotopes, the creating of radioactive materials or conducting neutron diffraction studies, as illustrated by Exhibit 5, it is possible to determine the number of megawatt hours devoted to each purpose.

It is evident at this point that, to use the megawatt hour basis for determining reactor usage, it is necessary to assume that the reactor is operated at all times at full core capacity and at maximum power level. When nuclear reactor usage is available to American industry on a commercial basis, this assumption would not be unrealistic. However, at the outset, it appears very impractical to consider that such will be the case. On the other hand, if the full cost of operating a nuclear reactor facility is to be recovered, it will be necessary to cost utilization at less than full producion scale, at a decidedly high premium.

While it is possible to conduct diffraction studies and produce radioactive isotopes at thermal temperatures less than the maximum power level of the reactor, the number of megawatt hours of energy applicable to each purpose is a measure of the neutrons used. Also, it is never necessary that the entire core capacity (space) be used for certain purposes. Conversely, to conduct a single experiment or to create the necessary fission process that must occur, a prescribed amount of source material in the form of fuel elements must be present which, if used at capacity, *can* create the maximum power level for which the reactor was designed and *will* produce the energy required to effectively accomplish the purpose of the entire core space. As a result, a sliding scale of cost per megawatt hour must be established, which will arithmetically provide for the full recovery of cost when the reactor is utilized at less than full power and space capacity. A simple illustration of this variable costing is as follows:

Legend:

| | |
|---|---|
| Maximum power level | 5 megawatts |
| Maximum core space | 24 Irradiation spaces |
| Total operating time (90 das) | 960 Hours |
| Maximum fuel rod life | 90 Days |
| Total operating cost (90 das) | $345,600 |

Formula:

$$\frac{\text{Total cost}}{\text{Operating time} \times \text{Power level} \times \text{Core space}}$$

Full capacity

$$\frac{\$345{,}600}{960 \times 5 \times 24} = \$3.00 \quad \text{MW Hr per core space}$$

50% capacity Power level

$$\frac{\$345{,}600}{960 \times 2.5 \times 24} = \$6.00 \quad \text{MW Hr. per core space}$$

50% Capacity Core space

$$\frac{\$345{,}600}{960 \times 5 \times 12} = \$6.00$$

50% Capacity Core Space & Power level:

$$\frac{\$345{,}600}{960 \times 2.5 \times 12} = \$12.00$$

Standards employed in this method of costing must be revised periodically to conform with life expectancy of the source material from which the fuel

elements are manufactured. Fluctuations in the cost of uranium and processing of fuel elements, and credits resulting from residual scrap returned to the supplier, can result in sizable cost variances between different batches of source material. If, however, sliding scale rates of costing reactor usage are fixed for each period in advance, based on expected megawatt hours of usage, and variance accounts for each element of cost—material, direct labor, indirect labor, and general and administrative expense—are maintained on the basis of actual reactor usage, it is quite likely that industrial reactor operators will find that the megawatt hour method of pricing will prove more realistic than other methods, due to the number of uncontrollable characteristics of atomic energy which make costing and cost accounting far more difficult than any circumstances present in the manufacturing and processing operations of previously known technologies.

Attempts have been made to cost nuclear reactor output on the basis of relating expense to the energy generated by each fuel element or rod. Aside from the necessity of assuming that each rod produced an equal number of neutrons, voluminous records have been required to record initial rod costs and subsequent expenses resulting from rod handling and storing after they had been prepared for insertion in the reactor but prior to their becoming part of the "hot pile." Similarly, it has been necessary to identify (if possible) the uranium processing losses and residual scrap recovery by individual rods, to arrive at final actual costs. This method of costing has not gained much acceptance and, where presently used, has been modified to an averaging basis for all rods or batch of rods, to avoid wide variances experienced in source material efficiency and productive life span.

It can be conservatively stated that general purposes reactors will present the most difficult problems of cost accounting, and it is for this reason that the megawatt hour of usage appears to be the most realistic manner in which to arrive at the true cost of applying this science to the industrial problems of the world. Power reactors, built to supply electrical energy, lend themselves more readily to normal costing, although present techniques have not been developed to the stage where electrical power can be produced commercially on a true cost recovery basis. This, however, is a matter of economic and scientific development, both of which will be solved by the passage of time in the atomic age.

### *Accounting and the Atomic Age*

Accounting in the atomic age will undergo many changes in both philosophy and technique. Atomic energy is the child of many basic sciences, i.e., chemis-

try, physics, mathematics, and engineering. Hence, it is an art requiring a high degree of intellect on the part of all who seek its many offerings. If the accountant intends to join with the atom in contributing to the industrial benefits that certainly will ensue, he must prepare now by investigating the accounting problems that are resulting from the operation of nuclear reactors and the many industrial processes that will use radioactive materials.

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## WHAT TRAINING FOR COST ACCOUNTANTS? by Frank Judd*

WHERE WILL WE FIND the cost accountants who will run the management services stemming from cost accounting ten and twenty years hence?

If we review the records of the leaders in the profession and of our associates in our companies (not mutually exclusive groups), we find that most of the men in the field have come from general accounting or public accounting, with a pretty generous sprinkling of people who have "come up" from the production floor. In many ways, it may seem odd that the profession of cost accounting has not established a more specific identity extending to educational training. Can we have such a course of study for cost accountants or, for that matter, should we? I have often asked myself this question, especially since my daily function is the management of cost control and analytical services in a fairly large multiplant company and I am also teaching advanced management accounting subjects at night at the local university.

Traditionally, the teaching of accounting at our universities has been patterned along the interests of public accounting. The emphasis has been on general accounting principles, classification of balance sheet items, and fair statement of income by periods. These elements are needed knowledge for anybody in all fields of accounting. In addition, colleges usually offer elementary or advanced cost accounting and may have courses in industrial accounting or business budgeting.

However, if we are clear in our thinking, I believe that we would have to admit that the schools cannot make cost accountants for us beyond a certain point. The public accountants may make the same statement for their profession. Yet, public accounting work, fortunately for our financial system, is a great deal more standardized than cost accounting and the managerial services stemming from it will ever be. Our "subjects," meaning practical applications, are tailored to

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the specific needs of our particular organizations and are designed to serve our particular managements.

When I say "tailored," I mean not only to objective standards and requirements but also to individual and personal preferences. I do not see anything wrong in admitting that management services must work in terms of individuals in the management. Objectives in our company in 1958 may not be objectives in 1960, and it may be necessary to recast reports and even classifications to suit the changing needs. Another new factor is the growing utilization of different data processing techniques, which adds a new dimension to the activities of the management cost accountant.

If we now step back and consider how a university could train staff men for us, I feel that we should expect:

1. Understanding of accounting principles and their objectives.
2. Understanding of business management principles and their objectives.
3. General education based on studies of economics, history, and other liberal arts.

When we get a man with this training, he will be able to understand and observe the techniques and practices that we now use and he will, if he has got what it takes by way of personal ability, carry on and improve on what we now have. I believe that an attempt to put more specific management technique courses into curricula would not be too decisive because what we need is development of thinking, rather than knowledge of specific systems used by particular companies. I believe it would be wrong to push the universities still further into the direction of a trade school. We will benefit more if our men bring education.

# A Middle Ground Between Fixed and Flexible Budgeting

by E. H. WEINWURM

THE CONCEPT OF WHAT BUDGETING should do, may range, in the minds of the general executive echelon of the company, very far from what actually is within the command of the accounting department. Much is lost either way. If understated definitions based on older and more broadly circulated authorities are the present guide, the current efforts of the accounting department to improve things will be discounted or even criticized as too complex. If the sophisticated modern approaches are promulgated and accepted too readily, things hoped for are unlikely to be seen. What budget, as the sole tool, ever produced a dollar of sales? Or even served to optimize volume-profit relationships where, as in the case of most industrial organizations, the system of accounting classification has not yet developed far enough to define, beyond reasonable doubt, the break-even points for varying economic circumstances?

It follows that what must be done is to develop more ideas in the middle ground, recognizing that break-throughs in business science are evolutionary unless expensive crash programs are undertaken, the same as in the realm of physical sciences.

## *Origins and Development of Budgeting*

Now, there is no doubt that the budgeting concept is improving controls in the long effort to lift business management from the guessing stage. By forcing operations into more intimate contact with accounting people, it is helping to mold our systems of classification and the skills of organization to communicate. As a result, more and better factual information, is available and the control process is becoming increasingly scientific. Though simple business budgeting has been practiced for many years, it has certainly not approached its limits. This is true both in terms of the number of companies using budget systems and in the managerial effectiveness they are able to provide within the given company.

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When budgeting was first applied, it was, of course, not a new idea that a planned activity would be more apt to reach specified goals than one which was not planned. Yet the obstacles to applying the idea within a practical procedural frame-work seemed overwhelming at the beginning and they are still quite substantial. The earliest business budgets were crude estimates in comparison with their successors of a generation later. They had to use the few statistical and accounting data available at the time. The inadequacy of those data was strongly felt as more experience was gained from their use.

One attempt to better the situation originated in the accounting area, namely, the introduction of predetermined burden rates. Here was one of the origins of budgeting. As a matter of fact, many writers and practitioners still use the term "budget" as the equivalent of "overhead budget," which originally served as a tool to develop burden rates. Another pioneering effort had its roots in the field of economics and statistics. *The Harvard Business Barometer,* first published in 1918, showed the way toward improved forecasting of business developments. Though it was concerned with stock market fluctuations and had to be discontinued after a few years, it led to more thorough studies of the factors which helped sales forecasting toward more reliable maturity.

As we look back at what happened in the first stages, it seems almost inevitable that:

1. The emergence of the budgetary concept would be unilateral in the accounting function or, in other words, that more ingenious accountants would seize on the notion that the accounting system could be better adapted to calling the company shots in advance.
2. Inquiry by these people into how the system could be directed to doing this would entail for the first time looking at not only the character of charges which went into the respective accounts but also into essential behavior of these charges.
3. Accountants, being confronted with practical immediacies (such concepts as semi-variable costs, for example, had not been clearly formulated at the time) would at once resort to fixing the budgetary projections to relatively inflexible amounts prorated monthly over an annual period.

Possibly the chief benefit of the preceding series of events was general acceptance of the idea of classifying costs broadly in the sense that they were either fixed or variable. This is simply illustrated in Exhibit 1. It was seen, by use of this type of chart, that total cost in any particular activity could be determined immediately. Further, the concept was a simple educational tool through which accountants could readily generate management thinking and

understanding concerning the relationship of these two types of costs within the enterprise. The break-even chart, which soon followed by the superimposition of the sales curve, was only one step removed and would eventually provide management with a simple representation of an even more valid induction concerning what was to govern future budgetary practice.

These things accomplished, a number of budgets were assembled, approved by management, and directed to operations for compliance. However, as soon as comparisons of what was actually going on were made with what the budget said should be going on, the distortion inherent in fixed budgeting came into the open. Immediately operations personnel began taking pains to tell the accountants how and why costs could not fluctuate with volume in a uniform and easily determinable manner Fortunately, the idea of budgeting had sufficient merit in furnishing broad estimates of expected costs at various levels, so that it survived and the break-even concept became the foundation of the fixed budget.

### Why Normal Volume

Another complication promptly presented itself. In most industries, the volume of sales and production will fluctuate substantially over time. How can the fixed budget deal with this situation? If attention is focused on the total budget period (say one year), the fluctuations may be disregarded altogether as long as it can be expected that actual costs for the period will reasonably match the budgeted figures. Yet business management has become increasingly interested in reports for shorter periods. If, for instance, it wanted monthly data, it could no longer disregard those volume fluctuations during the longer period. Yet, this disregard was the traditional practice of burden application. During low-volume periods, actual costs would exceed the amount of predetermined burden charged to production, which was based on annual volume. The difference or under-absorbed burden would be carried forward until the end of the year in the expectation that, at that time, no substantial difference would remain. The burden rate was based on an assumed normal volume.

Would change in determination of normal volume help? There are numerous normal volume concepts which emphasize different factors, such as capacity to produce, capacity leading to a minimum unit cost, capacity related to a longer-range sales volume and others. Obviously, the particular normal volume concept which underlies a budget will significantly influence the difference or variance between actual and budgeted data. This important question will be taken up in a subsequent section.

### *Introduction of the Flexible Budget*

As management became more familiar with the services which budgets could provide, the limitations of the fixed budget were more fully recognized. In addition, a new important aspect of budgeting was gradually evolved. No longer was management satisfied with the use of budgets for planning purposes. It was realized that a plan was only as good as its execution. Management wanted to be assured at short intervals that its plans were carried out by all parts of the organization. If this was not the case, management wanted to know the reasons for the failure. This was the origin of two highly important budget applications, communication and control.

The problem of communication is a complex one for all kinds of organizations. Budgeting has been discovered to be one of the most effective means to achieve adequate communication. Management has a tool through which every supervisor helps to establish the plan and knows what is expected of him. His performance in carrying out the assignment is "fed-back" to management which, in turn, can decide what to do to bridge the gap between planning and execution. Another important aspect of communication arises between operating and financial people. Accountants must know what is going on in the plant; operating supervisors must learn to use the data which the financial departments are computing and analyzing. The use of the budget as a control device has been a prerequisite for its successful use as a communication medium. Yet the fixed budget did not fit the requirements of control.

In using budgets for planning, management could disregard the shorter-run fluctuations, as long as it was satisfied with data which incorporated the optimistic assumption regarding a final agreement between actual costs incurred and predetermined burden charged into production. But fixed budgets were failures as short-term control

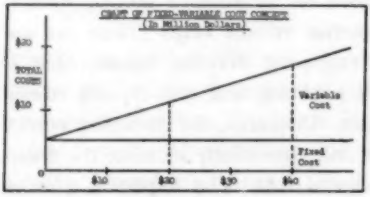


EXHIBIT 1

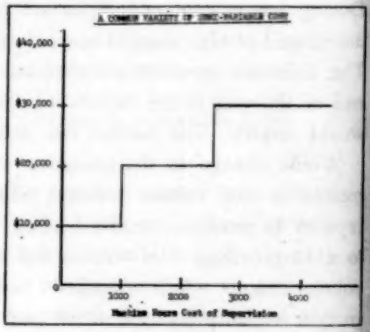


EXHIBIT 2

tools despite the fact that some business executives are still unaware of it. Since the 1930's, the promotional efforts of Fred V. Gardner and his supporters have put the spotlight on the advantages of flexible budget. Their work has been so successful that there has been a trend to dismiss fixed budgets altogether, even under conditions where they can render services which variable budgets cannot furnish.

The flexible budget discards the limitations and assumptions of the fixed budget and the break-even chart. It attempts to determine costs at different activity levels through actual measurement rather than merely by formal period prorations. While this requires much more time, effort and money than to design a fixed budget, the flexible budget has an all-important advantage as a control tool in scheduling costs validly to the actually expected activity volume. With a fixed budget, a manager is bound to lose control whenever the actual activity level deviates from the normal or average volume on which the data of the fixed budget are based. The requirements of flexible budgeting for more detailed and accurate data have stimulated substantial improvements and refinements of accounting data.

Exhibit 2 illustrates the flexible budget curve for one type of semi-variable costs. It is neither fixed nor variable according to the assumptions underlying the fixed budget. Neither can it be segregated into its fixed and variable components by means of one of the simple formulas to be found in the literature. The number of supervisors needed—which determines the cost—must be ascertained by a careful study of existing conditions, which may well differ from one department to another. Other cost classifications will show different types of curves in a graphic presentation. Thus, the artificial uniformity of the fixed budget is reshaped into more suitable operating control. The curves recognize different conditions; these conditions were submerged in the fixed budget as a result of the simplifying assumptions used in its construction.

### *Contrasts in Usefulness Between Fixed and Flexible Budgets*

Proper analysis of budget variances should be a matter of importance appreciated by management, for it will provide valuable information about out-of-line situations. However, the type of budget in use will have a significant impact on the variance figures. Appropriate interest must be devoted to this situation to avoid misleading interpretation of the budget variances.

Variances developed from a flexible budget will be comparatively small in most instances unlesss there have been price fluctuations or other events which were not anticipated when the budget data were accumulated. The reasons

should be readily apparent. The flexible budget is supposed to reflect the conditions under which the supervisor is expected to operate. It must be assumed that the expense ceilings have been carefully determined and adjusted to the anticipated level of activity. It should be feasible to anticipate conditions for a short period rather accurately. The better this has been accomplished, the smaller should be the variances. The principal exception would be circumstances beyond the supervisor's control. Thus, it appears that the amount of the variance may reflect the ability of the forecasters who prepared the budget data, as well as that of the supervisor to keep his costs under control.

The situation is quite different in the case of a fixed budget. Here the variances may well be comparatively large. For they reflect not only the difference between the normal or average and the actual activity volume but also other fluctuations which have not been incorporated in the fixed budget. For this budget has been prepared with one particular kind of conditions in mind; whenever actual conditions deviate from those anticipated ones; there will be a variance. And this will occur quite frequently in a period like the present when changes are common.

The question arises as to the managerial significance of the several types of budget variances as they occur under the different budgetary systems. Which one of the systems is the more useful from a management point of view? This is certainly an important and legitimate question. If it should be found that one system is more valuable to management than another, then the former should be given preference over the latter. This should be done, even if the more useful system is the more expensive one. Comparative cost data are not meaningful in absolute terms but only with a view to their usefulness to management.

Is it practical to make a choice between fixed and variable budgets from the point of view indicated above? Should one type of budget be generally preferred over the other? This is a question which should be of great interest to both managers and budget people. The available evidence seems to point in the direction of the variable budget as the more valuable tool. The shortcomings of the fixed budget are now widely recognized. It is common to hear the statement that only a flexible budget is a true budget. Those operating a fixed budget often take a somewhat apologetic attitude and point to the cost of administering an alternative as the principal reason why they still use the fixed budget. They would not deny the many advantages of the variable budget. However, it still may be inadvisable to eliminate the fixed budget, thus to deprive management of a valuable tool for which it has no adequate substitute in current, low-cost operation.

Some of the problems of normal volume have been discussed before. Mod-

ern managerial techniques rely on measures which are intended to represent standard performance. It is recognized that actual data have little meaning without reference to a standard measure or bench-mark. The concept of the budget, itself, is a reflection of this philosophy. Attempts to determine a normal volume should be looked upon with this back-ground in mind. This is particularly necessary since the promoters of direct costing have tended to deprecate and minimize the value of the normal volume concept. In their opinion, one of the major advantages of direct costing methods is that they do not require determination of a normal volume, which is said to be an almost impossible task. This is not the place to evaluate the significance of the various concepts of normal volume which have been mentioned before. The concept of normal should be realistic, if it is expected to serve as a managerial tool. "Normal" here should be interpreted in a manner similar to that used in setting of standards, to mean that it should be attainable under reasonably considered or usual conditions. Thus normal volume should be an attainable volume—not one based on a long-term trend extrapolation which may or may not materialize.

A relatively fixed concept of normal volume has considerable value to management because it "stays in one" place long enough to become familiar as the reference point. This being true, then management can proceed to measure the extent to which the actually attained volume compares with the normal volume. If the fixed budget be based upon this concept of normal, the variance representing the difference between actual performance and the fixed budget will continue to be a valuable management tool, even if variable budget data are available in the organization. The variances developed from the comparison of actual performance and the flexible budget are not substitute for those discussed before.

### *Toward a Solution: Planning Versus Control Variances*

This analysis generates the idea that, so far, the opinion of the superiority of the flexible over the fixed budget cannot be sustained without exceptions. While the flexible budget has outstanding advantages as a control tool, it can fail to provide the important information which is represented by the variance between the original (normal) goal and the actual accomplishment. Neither type of budget can furnish all the essential facts which management needs. It appears that we do not have to choose between two alternatives but rather should combine both types to give management a maximum of useful information. Each type of budget, with the variances characterizing it, has a different significance. The variances derived from the flexible budget are essential control

tools for supervisory management. The fixed budget, on the other hand, tells upper management to what extent its original plans have materialized through actual performance. This is a middle ground which promises greater benefits than its cost of administration, and can lead to more adequate later development of variable budgeting, as our accounting systems evolve.

The overall usefulness of the analysis of budget variances, therefore, can be substantially increased if two kinds of variances are computed namely:

1. Planning variances (based primarily on the historical fixed budget).
2. Control variances (based primarily on a simplified variable budgeting approach).

The planning variances indicate the difference between the original budget estimates and the actual performance. These variances may be subdivided further by comparing the actual data, either with those developed on the basis of a normal volume or with those computed at a volume which was determined at the time when the budget was being prepared. The two sets of data will coincide if the volume anticipated at the time of budget preparation is identical with the normal volume. Whether or not this will happen will depend largely on the concept of normal used in connection with the preparation of the budget. But it should be noted that both volume variances will provide valuable information to management. For example, a company may use a concept of normal which reflects a five-year average and compare actual data with those computed from that concept of normal volume. The volume estimate for the next year budget might deviate considerably from the average normal volume. As a result, the variances derived from the twelve-months volume could differ substantially from those based on the normal volume.

The planning variances will reflect mainly the extent of utilization of available facilities as they affect costs and profits. A large unfavorable variance between actual and normal will be a constant reminder to management of the penalty it has to pay for a policy which has failed to provide a consistent balance between capacity and sales. On the other hand, recurring favorable variances will indicate the need to think about an expansion of existing facilities, together with related problems of financing, etc. The variances between actual volume and that forecast in the short-range budget will often reflect inefficiencies in scheduling procedures, inventory policies and so on.

The significance of the planning variances will depend to a large extent on the accuracy in forecasting volume, revenues and costs. The more careful these estimates, the more valuable will be the information presented by the variances.

Their thorough analysis should supply management with an important guide for improving future planning techniques. The control variances should not need any particular recommendation and discussion. Their indispensability is generally recognized. They furnish the supervisor with the invaluable yardstick for determining his ability to operate within the budgetary ceilings which he has himself accepted as practical at the time when the budget was prepared. Once a supervisor understands fully what the control variances can do to help him toward improving his own performance, he will treasure them among his most valuable performance tools.

### *An Illustration*

The "X" Manufacturing Company is a medium-size producer of metal stampings for the electronics industry. Production volume fluctuates widely; it reaches a peak in the fall but is quite low during the rest of the year. Working for stock during the dull period as a means to smooth out the volume fluctuations is impractical in view of frequent and often sudden changes in specifications prescribed by the customers. The company has been operating a budget system for a number of years. It is based on a normal volume decided upon by management on the basis of practices in the industry. Actually, the average annual volume has been substantially below the normal volume. Thus there are three kinds of volume: the normal volume, the average annual volume, and the actual volume scheduled for a monthly production period which is either much lower or much higher than the annual average.

This budget system produces large unfavorable volume variances since burden rates were computed from the normal volume and, thus, were inadequate to absorb the overhead which could be charged into production during the low-volume periods. The question of how to interpret these unfavorable variances was hotly debated within the management. Financial officers maintained that they indicated that the company was operating "in the red." Operating executives denied this and insisted that the company was earning a satisfactory return on its investment. Thus, instead of better information, there was only confusion as to the meaning of what was actually the planning variance.

But the situation was equally unfortunate with regard to the control variance. The budget was of no help to operating management. All that supervisors had available was the overhead budget based on the normal volume, divided by thirteen to represent a monthly allowance. But the actual volume was never normal. As was mentioned before; it was always lower, with the exception of two or three months, and then it was substantially higher. The result was not

unexpected. Since the monthly budget allowances did not furnish the supervisor with any guidance, they were disregarded as time went on. The cost accountant continued to compute the variances in a routine fashion, but plant personnel gave hardly any attention to them.

It was apparent that this fixed-type budget based on an unrealistic normal production volume failed to serve its purpose, particularly from a control point of view. A consultant called in for advice had no trouble in diagnosing the situation and offering appropriate advice. Two major changes had to be made to put the budget on a satisfactory track. First, a realistic attainable operating volume had to be determined which would be used in the computation of the annual budget. It would reflect average activity during the year and could serve for pricing and/or inventory valuation purposes. Second, a flexible-type budget was needed which would reflect actual volume conditions and serve as a yardstick for operating supervision. This budget would indicate expense allowances for activity levels expected during the year.

Here was a situation in which the computation of two planning variances and a control variance should be a most valuable help to the several levels of management in planning future policies, as well as in evaluating current performance.

The planning variance related to normal volume would indicate to management how better utilization of available facilities could improve profitability. The unfavorable variance did not represent an actual but rather a potential loss: failure to take advantage of existing profit opportunities. It would help to keep management alert to the need for devising better policies to narrow the gap between actual and potential profits. This could be accomplished either through increased business or a reduction of unused facilities as a result of disposal or conversion to some other kind of production.

The planning variance related to expected volume would reflect mistakes in forecasting production volume at the time when the budget was computed. This variance would indicate the need to change production planning schedules and/or to improve forecasting techniques used in preparing budget data. Since the expected volume would not necessarily agree with the monthly actual volume this would represent a variance also. But, as long as the annual volume has been correctly predetermined, this variance would merely reflect seasonal fluctuations. Once it appears that the expected annual volume would not be attained, the variance in excess of the seasonal fluctuations would call for managerial decisions.

Although the planning variances are the primary concern of top management, the control variances will measure the effectiveness of operating management

to work within budgetary ceilings based on actual activity volume. Exhibit 3 presents a greatly condensed version of a variance analysis report; it illustrates a possible method for providing management with the fundamental data derived from the comparison of plans with performance. To get a maximum benefit from such an analysis, the control variances should be broken down by responsibilities so as to make it possible to identify the effectiveness of individual supervisors in keeping within their budgetary allowances.

"X" MANUFACTURING COMPANY
ANALYSIS OF BUDGET VARIANCES FOR THE YEAR 1957

| Volume | Machine Hours | Fixed-type | Variable-type | Total |
|---|---|---|---|---|
| 1. Normal | 100,000 | $2,000,000 | $2,000,000 | $4,000,000 |
| 2. Expected | 80,000 | 1,900,000 | 1,650,000 | 3,550,000 |
| 3. Actual | 70,000 | 1,900,000* | 1,450,000 | 3,350,000 |
| 4. Actual | | 1,900,000** | 1,520,000 | 3,420,000 |

*Expected expenses at actual volume **Actual expenses at actual volume

| Variances | | | |
|---|---|---|---|
| Planning variance at normal | ( 1 - 2 ) | $450,000 | |
| Planning variance at actual | ( 2 - 3a ) | 200,000 | |
| Planning variance total | ( 1 - 3a ) | | $ 650,000 |
| Control variance | ( 3a - 3b ) | | 70,000 |

Responsibility for planning variance: Top management
Responsibility for control variance: Operating management

**EXHIBIT 3**

The total variance for each responsible official may then be further broken down by individual expense classifications to determine the kinds of cost which exceeded the budget. This is the first indispensable step toward exploring the cause of a variance and taking action toward its reduction or elimination. How far the detailed breakdowns of variances should be carried depends primarily on the interest shown by the various management levels. Computing data which management does not consider useful represents a waste and should be avoided. The question as to the type of data and reports which should be prepared should never be a routine task but the result of careful studies based on discussion with the users of those data.

### *A Practical View*

To make a budgetary system a valuable tool for communication, planning and control constitute a task which will never come to an end. There will

always be ample room for improvement in the use of existing data as well as in the methods of their computation. Variance analysis is an essential part of the budgetary program. Maximum use should be made of the information contained in the variances. Their scope should be fully understood by those who have to use them. Each type of variance has its peculiar uses but also its limitations which should not be overlooked. It is an important duty of the budget director to make sure that no misunderstandings remain in the minds of those who need the variances and have to work with them.

It may be hoped that more attention will be paid to the middle ground as budgetary thinking goes along. The really advanced concepts of non-accountants who have written new theories on budgeting are excellent. However, they have paid too little attention to the cost and technical problems inherent in molding good accounting systems and in the problem of training industrial accounting organizations, which must ensue. It is a hard fact that, even if all of our detail reporting systems were capable of producing information of the kind hoped for—the sure-fire profit or efficiency formula—we may possibly require years to train even a small nucleus of accounting analysts to modify the resulting reports and explain the meaning clearly to management.

On the other hand, it is up to accountants to be aware of these ideas and to pay a measure of concerned attention to improvements in the middle ground, for here changes required in practice are not as drastic and make it easier for the accountants to keep things simple. And doing this meets a need for improving the grasp by management of budgetary principles. The ideas in this direction submitted in this article, are but few among many possibilities which appear to have quick potential in this middle ground. Blue sky theorizing is great, but the blue chips depend upon a successful reduction to practice of a few components at a time.

# Practical Budgetary Control of Research and Development Costs

by D. H. COLBY

TEN YEARS AGO an accountant would have had a very great chance of failing in an attempt at instituting budgetary controls for an engineering group. I should like to describe the methods which we use to meet the requirements of our management for adequate budgetary controls in this area. Our present system is the result of six years' work in the area of engineering budgets.

As in all budgeting, it is necessary to take a forward look at engineering expenditures. In order that management may make comparisons and evaluations in light of total company spending versus income, it is reasonable to expect a complete and detailed budget analysis from engineering groups. Further, it is possible to gain maximum utilization of funds through a projected analysis of the results anticipated from expenditures on specific programs. In other words, the engineering groups should be steered into a position of establishing firm and detailed objectives for accomplishment in order to justify spending budgeted dollars. By this method, we have been successful in attaining two ends:

1. We found that, through actual planning for accomplishment, more significant results were gained.
2. Programs for which no end result is anticipated or for which the end values are cloudy, are spotlighted and can be readily separated for review and criticism.

### From the Financial to the Project Budget

We require each project engineer to submit his annual personnel requirements on a project basis. The results are summarized and submitted by section heads on a schedule similar to Exhibit 1, Personnel Requirement Budget Work Sheet. In addition, the section head and plant accountant review a detailed list of personnel, anticipating changes or additions for the coming year. This listing must be tied in with Exhibit 1. From the detailed schedule of personnel, we arrive at average hourly rates by classification, i.e., senior engineer, engineer,

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technician, master craftsmen and electricians. This gives us total labor dollars for each department and the basis for building expense budgets and overhead rates.

Our first step is to divide our total expenses into three categories: labor costs controllable (or out-of-pocket) expenses and fixed costs. A typical schedule follows:

| *Labor* | *Controllable expenses* | | *Fixed costs* | |
|---|---|---|---|---|
| Wages | Materials | Maintenance | Power | Depreciation |
| Overtime premium | Supplies | Subscriptions | Water | Occupancy |
| Fringe benefits | Travel | Dues | Insurance | Administrative |
| | Telephone | Services | | |

We ask our section heads to give us their requirements in the controllable category. Their estimates are then tempered by past experience, available dollars and the judgment of our chief engineer. Following a final review, the amounts are fixed and become part of the budget. It is this category which we hold section heads accountable for, as being directly controlled by them. We have found that our fixed costs will remain more or less constant for a one-year period. Power and water are measured by meters. Insurance is prorated on the basis of investment and occupancy on a square foot basis. Depreciation is merely a bookkeeping problem and administrative costs are prorated on the basis of number of professional engineers. Under labor, fringe benefits include paid vacations, holidays, pension contributions, hospitalization plans, awards and various unemployment and social security taxes.

The next step is to calculate overhead rates for purposes of determining project budgets, monthly forecasts and for estimating. The formula we use is as follows:

| | | | | |
|---|---|---|---|---|
| Total labor costs | $16,800 | Total budget | | $32,346 |
| Less supervision | 1,620 | Less: Direct labor | $15,180 | |
| Direct labor base | $15,180 | Direct chgs. (2) | 2,125 | 17,305 |
| | | Overhead base | | $15,041 |

Overhead base ÷ Direct labor base = Overhead % or 15,041 ÷ 15,180 = 100%

(1) Supervision for this purpose includes section head, secretary and clerks.

(2) Direct charges are those directly applicable to specific projects such as materials, travel, professional services, etc.

Certain costs are transferred out of research and development. These items are divided into three categories. The first is costs transferred to manufacturing operations. This would include charges on an hourly basis for services of the testing laboratory and machine shop. The second category is reimbursed costs for work on government developmental contracts. The third is production of goods for sale to customers.

PERSONNEL REQUIREMENTS BUDGET WORK SHEET (DEPT. & APPLICATIONS)

| PROJ. NO. | TITLE | ASSIGNED TO | HOURS SR. ENGR. | HOURS ENGR. | HOURS TECH. | HOURS MACH. SHOP | HOURS LIFE TEST | $ DIRECT CHARGES |
|---|---|---|---|---|---|---|---|---|
| 155 | Incandescent - Applications | Jones | --- | 1,000 | 1,000 | 50 | 200 | 2,500 |
| 205 | Fluorescent - Applications | Smith | 600 | 260 | 2,300 | 50 | 100 | 9,360 |
| 228 | Runway Lighting | White | 100 | 100 | 300 | 10 | 50 | 3,000 |
| 231 | Flash Tube Applications | Brown | 200 | --- | 270 | 30 | --- | 3,000 |
| 232 | Base Development | Gray | 500 | 500 | 2,000 | 100 | 25 | 14,700 |
| 255 | Core Assembly Machine | Murphy | --- | --- | 300 | --- | --- | --- |

**EXHIBIT 1**

All of the factors are summarized in Exhibit 2, Budget Report of Engineering Expense, for each section and the entire department. This financial summary is the basis for our budget presentation and it is the yardstick by which management measures us monthly.

From the personnel requirement budget sheets, Exhibit 1, we also derive our annual project budgets. Labor is extended by previously calculated cost rates and, to these figures, is added an amount of anticipated direct charges. Projects are summarized and this summary is tied out to total section financial budgets and to the entire engineering financial budget. At this point, in suport of a request for funds, we are able to specify how much we intend spending, what the specific items of expense are, and for what projects funds will be spent.

BUDGET REPORT OF ENGINEERING EXPENSE DEPARTMENT

| Acct. No. | Items | Monthly Budget 1958 | Monthly Budget 1957 | Comments |
|---|---|---|---|---|
| | Labor, O/T. & Fringe Benefits | | | |
| 81 | Awards and Prizes | | | |
| | | | | |
| | | | | |
| | Sub-Total Payroll Expense | | | |
| | Controllable Expenses: | | | |
| 01 | Maint.-Mach. & Equip. | | | |
| 04 | Small Tools | | | |
| | | | | |
| 62 | Maint.-Test Equipment | | | |
| | Sub-Total Expense | | | |
| | Fixed Charges | | | |
| | Total Engineering Costs | | | |
| | Costs Transferred Out: | | | |
| | To Manufacturing Operations | | | |
| | Government Contracts | | | |
| | Production for Sale | | | |
| | Net Engineering Costs | | | |
| | | | | |
| | Total Employees | | | |
| | Days Worked | | | |
| | Ave. Cost/Hr./Engr. | | | |

**EXHIBIT 2**

TEMPORARY NEW PROJECT AUTHORIZATION (EFFECTIVE FOR 30 DAYS ONLY)

Brief Title: Extended Cathode Development — long range / X short term

Product Line:
- Incandescent
- X Fluorescent
- Flash
- Projection
- Transformer
- Starters&Cir. Breaker
- Coils
- Other (specify)

Department:
- Applications
- X Labs
- P. D. E.
- Incandescent
- Life Test
- Non Classified

Activity:
- Basic Research
- Net Products

- X Product Improvement
- Cost Reduction
- Equipment Development
- Factory Assistance
- Field & Commercial

Phases:
- Exploratory
- X Design & Development
- Prove — Pilot Stage
- Manufacturing Engineering

Assigned To: J. Parker — Date: 3/5/58

Related Project: Cathode Research

Estimated Amount Needed for This Authorization..... $ 9,875

Approvals:

Dept. Head: F. A. Jones — Admin. Asst: R. R. Smith

Plant Accountant: D. H. Colby — Chief Engineer: L. B. Mitch

**EXHIBIT 3**

PROJECT AUTHORIZATION

Project No. ☐☐☐

Date Submitted
Phase I
II
III
IV

Dept.
Prod. Line
Assigned To

Title:
Description:
Purpose and Potential:

Estimated Total Cost:

| Phase | I | II | III | IV |
|---|---|---|---|---|
| Phase End Date | | | | |
| No. of Personnel | | | | |
| Est. Hours | | | | |
| Labor $ | | | | |
| Expense $ | | | | |
| Capital $ | | | | |
| Total Cost | | | | |
| | Approvals | | | |
| Review Date | | | | |
| Dept. Head | | | | |
| Accounting | | | | |
| Administrative | | | | |

**EXHIBIT 4**

### *Project Authorizations and the Monthly Budget Request*

It is wise always to review project authorizations in light of project budgets. The project authorization is another form of budget, inasmuch as it represents the total anticipated cost for a specific project. We require a detailed write-up for each project within 30 days of its inception, and it represents the engineer's request for funds as well as an evaluation of anticipated values to the company. Exhibit 3 is the initial request used to set up code numbers, define the project and get it started. Exhibit 4 is a more detailed form calling for a complete breakdown of needs and values. The purposes of a project authorization system can be stated as follows :

1. To keep management aware of new development and application of personnel and funds.
2. To define specific project objectives and to evaluate them.
3. To establish dollar limits of expenditures for control, based upon the anticipated value of end results.
4. To establish an account for the accumulation of costs and charges.
5. To indicate to management that we have expenditures under control and that the company's funds are being spent in a proper manner.

The complete project authorization request is reviewed for cost data and adequate description and evaluation, and is then presented to the division vice president (engineering) for his approval. More often, his approval or veto is given during a periodic review meeting when several requests will be considered at once. This sometimes requires a personal appearance by the project manager or section head to further support his request for allocation of funds. There are three types of projects requiring authorization. Original or new conceptions include projects which have no end product in view and those which are aimed toward a specific end product. Break-through or by-product types of projects are results of exploratory work in a general field or new application of an existing product. Specific requests projects represent sales department requests for a new product, projects on specific manufacturing problems, or contract work requiring a bid.

I feel that the needs for a successful project authorization system are five:

1. A simple approach to an immediate, temporary authorization, followed by a complete, detailed story.
2. Clarification of phases and classification of projects into proper categories for control.
3. Specific definition of new projects.

4. Cooperation on the part of section heads and project managers in initiating requests.
5. Follow-up and termination of completed projects and writing of completion report.

Finally, the objectives of an authorization system should be to establish a well-integrated system of control over projects. The purposes here are to plan more efficiently, explain with greater detail and clarity, establish the engineering function as a vital factor in company operations, and to review progress both from a physical and economic viewpoint.

GENERAL ENGINEERING DEPARTMENT – MONTHLY BUDGET REQUEST

Name: Department: Month:

| Project # | Title and Description | Job Due Date | Phase End Date | HOURS | | | | Direct Expense Items | Total Cost |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Within Dept. | Test & Meas | Mach. Shop | Other Depts. | | |

**EXHIBIT 5**

In order to control current operations, we require each project manager to submit his forecast for the coming month on the Monthly Budget Request. (Exhibit 5) This forecast outlines the jobs or steps which will be taken within each project, the man hours necessary, service department time required and a request for direct charge funds. We have found that, by budgeting direction of effort, the step-by-step accomplishments are more readily attained, resulting in faster resolution and completion of projects. In addition, we are assured that at least once a month each active project will undergo a realistic review of projected plans and results attained. By this method, we have succeeded in

GENERAL ENGINEERING BUDGET (MONTH)

| INCANDESCENT Proj. # | Non Classified | Inc. Engr. | Engr. Labs. | P.D.E. | P.D.S. | Applica. | Total |
|---|---|---|---|---|---|---|---|
| 289 | | $287 | $1,997 | | | | $2,284 |
| 281 | | 208 | 903 | | | $3,669 | 4,780 |
| 280 | | 144 | 866 | | | | 1,010 |
| 142 | | 29 | | | | 2,023 | 2,052 |
| 145 | | 72 | 513 | | | | 585 |
| 160 | | 1,376 | 252 | | | | 1,628 |
| 161 | | 1,959 | | | | 612 | 2,571 |
| 162 | | 1,760 | 714 | | | | 2,474 |
| 247 | 29 | 1,943 | 129 | | | | 2,101 |
| 236 | | | 166 | | | | 166 |
| 235 | | 353 | 172 | | | | 525 |
| 234 | | (780) | | | | | (780) |
| 232 | 752 | | | | | | 752 |
| Sub-Totals | $1,047 | $13,480 | $28,126 | | | $15,185 | $57,838 |

**EXHIBIT 6**

MONTHLY REPORT OF ENGINEERING EXPENSES

| Proj. No. | Description | Engineer | Actual | Budget | Cost to Date | Balance of Authorization |
|---|---|---|---|---|---|---|
| 123 | Turbo-Encabulator | Jones | $1,207 | $287 | $2,369 | $585 |
| 150 | Atomic Powered Lamp | Smith | 1,894 | 872 | 27,659 | 16,929 |
| 151 | Radio Freq. Transformer | Brown | 1,297 | 1,275 | 26,552 | 20,408 |
| 152 | Printed Circuits | Allen | 1,938 | 2,000 | 37,162 | 15,312 |
| 155 | A19 Lamp Series | Brooks | 1,011 | 2,297 | 4,126 | 2,874 |
| 158 | Flash Improvements | Bixby | 2,615 | 2,189 | 40,966 | 18,827 |
| 160 | Fluor. Cost Reduction | Carpenter | 1,343 | 1,376 | 26,145 | 28,137 |

**EXHIBIT 7**

eliminating much of the fumbling in early stages and have been able to resolve the objectives of projects with greater dispatch.

Monthly requests for allocation of cash funds for materials, supplies, services, test equipment and etc., must be supported by a brief explanation. In addition, these funds are governed by the total amount available for each section. In the event that monthly cash requests exceed total available (or financial budget) amounts, an additional review is made with the section head and adjustments are made by deferring some expenditures or reducing others. We do not forecast in excess of financial budgets.

Budgeted hours are extended by previously determined average departmental rates and total costs are summarized by project and department (Exhibit 6). The resulting figures are those each project manager is measured against and he must be prepared to explain deviations of actual from budget during a monthly review. Exhibit 7 is an example of our monthly project report showing results against monthly forecast, total amounts expended and authorized funds.

### *Making the Budget Equal Actual*

I should like to describe briefly a few very simple but effective guideposts which we use to ensure our actual costs being within budgeted amounts. In

APPLICATION SECTION — DAILY CASH PAYROLL

| | | | Amount | Balance |
|---|---|---|---|---|
| | | | | $5,900.00 |
| 7/31 | Leonard | Advance | $150.00 | 5,750.00 |
| 8/4 | Vickers | Advance | 200.00 | 5,550.00 |
| 8/4 | Requisitions | | 318.70 | 5,231.30 |
| 8/5 | Morris | Petty Cash Exp. | 9.96 | 5,221.34 |
| 8/5 | Smith | Petty Cash Exp. | 2.10 | 5,219.24 |
| 8/5 | Kline | Petty Cash Exp. | 8.05 | 5,211.19 |

**EXHIBIT 8**

order to control individual project leaders and sections, we operate on a monthly "checkbook" basis. In other words, the amounts which are requested as direct charge funds are set up at the beginning of the month as a deposit. (This is illustrated in Exhibit 8). Each purchase requisition, travel advance or travel expense voucher, and all amounts of overtime pay, are deducted from the beginning balance and a daily running balance is posted. These balances are issued as statements each Monday and, in the event a section runs out of money during the month, its chances of getting more are very slim. Additional funds can be obtained but the request must be supported by conclusive reasons for over-runs and it is subject to review and criticism. As a result these seldom occur.

DAILY BUDGET CONTROL

| | Invoices | Expense Books Petty Cash | Other | Fixed | Total | Accum. | Budget |
|---|---|---|---|---|---|---|---|
| 1 | | | | | | | |
| 2 | | | | | | | |
| 3 | $50.00 | | $47.50 | $4,090. | $4,187.50 | $4,187.50 | $5,052.00 |
| 4 | 243.69 | $60.15 | | 4,090. | 4,393.84 | 8,581.34 | 10,104.00 |
| 5 | 1,035.56 | | | 4,090. | 5,125.56 | 13,706.90 | 15,156.00 |
| 6 | 353.10 | 29.67 | | 4,090. | 4,472.77 | 18,179.67 | 20,208.00 |
| 7 | 1,445.71 | 98.07 | | 4,090. | 5,633.78 | 23,813.45 | 25,260.00 |

**EXHIBIT 9**

Our second guide is for the information of the accountant only. In order to have a close knowledge of exact total expenditures versus total budget, we have set up the Daily Budget Control shown in Exhibit 9. The importance of this control sheet is to provide a guide in making quick financial decisions during the month and in being able to give an accurate estimate of total costs immediately following the last work day.

### *Better Cost Control and Better Product Development*

The most important factors in making our budget system work can be explained in two words—awareness and cooperation. Success revolves around a constant program of keeping our people aware of costs and values, not only supervisors but engineers and technicians as well. We have operated within our budget, a very tight budget, for five years. This is a minor consideration however. The most significant result has been that we have developed a multitude of new products adding gross sales and net profits to the company profit and loss picture, while maintaining a realistic set of values and at a minimum of costs.

# Budgeting—The Art of Planning and Cooperation

by OSCAR H. CURRY

IN TRYING TO DEVELOP a useful program of budgeting at Campbell's, we have found that it can mean much more than a planning and control system. However, first, in order to understand its application and the role budgeting plays in our company, some background is necessary. We have been in business since 1869. We started manufacturing the famous Campbell's condensed soup with the familiar red and white label in 1897. Besides the Campbell trade mark, under which we sell soups, pork and beans and tomato juice, we are also the manufacturers of Franco-American Food Products, Swanson Food Products, both frozen and heat-processed, and V-8. For our 1957 fiscal year net sales were well over $400,000,000.

Our Campbell family numbers about 20,000 people. We have ten principal manufacturing plants in the United States and Canada and have operating facilities at nine other locations in both the United States and Canada where we carry on seasonal manufacturing operations, research and procurement activities. We are now building manufacturing plants in England and Italy and will soon start construction of a new plant in Portage La Prairie, just outside of Winnipeg in Manitoba, Canada.

We operate with a staff and line organization. Our plants are responsible for carrying on operations in accordance with policy and procedures established by the general staff. Our general offices are located at Camden, New Jersey. The completely centralized control over policy and procedure that is peculiar to our organization was developed because of our prime objective—to produce consistently the finest quality foods possible. Centralized control is necessary in order that the can of soup manufactured at our widely separated Sacramento and Camden plants will be of the same standard of quality and flavor as the one our product committee approved as representative of our company's objective.

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OSCAR H. CURRY, Philadelphia Chapter, 1941, is Vice President, Administrative Planning, Campbell Soup Company, Camden, New Jersey. He has been associated with this company since 1927, steadily advancing to his present position. Mr. Curry attended the Wharton School of the University of Pennsylvania.

Now, let us consider the subject of this paper. Webster defines art as skill dexterity or the ability to perform certain actions through experience, study, observation or knack. He also describes it as a skillful plan or device. However, he also describes it as cunning or artifice, and it is my belief that it is because some of us in management administer budgeting under this second definition that it has failed to have the organizational acceptance at all levels of management which would allow it to contribute its full potential to management effectiveness.

We created our company's first financial budget as an extra-curricular activity in the middle 1930's, more than 20 years ago. The model upon which we based our original objectives, in my opinion, is still the simplest and most effective explanation of a succesful budgeting program that I know. It is the model of a man planning an auto trip. I am sure no one would think of getting into his car one morning to drive across the country unless he had first planned his trip. Without this, he would doubtless know his starting point and his destination but he would have a pretty rough trip if he did not plan on how he was going to proceed. He would look over his car and decide whether the tires were adequate, have his motor tuned, plan the things that he wanted to do en route, and pack his suitcase accordingly. He would get road maps and study them, look up points of scenic beauty and, if he had business to transact, would plan that into his journey. He would consult with the automobile clubs about driving conditions and road conditions. If he were a working man, as most of us are, he would have a time schedule to meet and would have to estimate the cost of the trip and look over his own finances to make sure he was going to have the wherewithal for food, lodging, fun and gasoline. If he planned his trip well, he would have a happy one. He would have anticipated trouble areas and would have eliminated, to the fullest extent possible, breakdowns, delays, detours, and all of the things that might have made his trip an unpleasant one.

This is about as simple an explanation of the purpose of budgeting as one can find. But isn't there something more which, if we will stop to think, is so elementary that maybe too many of us overlook it? We have talked about one person making this trip. Few people would make such a journey across the country alone. Most of us are family people and, if our trip planner wants to enjoy a happy trip and he is going with his family, he had better cut them into the planning—and he had better do it without cunning or artifice if he expects their wholehearted cooperation in a successful and pleasurable journey. Here then should be the objective of any good budgeting program. The entire

organization should understand the company's objectives and should be allowed to participate in the planning and the creation of the road map, the budget, by which the objective is to be obtained. From such understanding and participation will come the initiative and the enthusiasm that will trigger successful performance and permit all participants to enjoy the after-glow of successful accomplishment.

### *From Long-Range Forecasting to the Sales Budget*

At Campbell Soup Company, we establish our future growth objectives for ten-year periods in the future. We re-examine these objectives each two years. We do this in order that our planned growth objectives will correlate with our current performance and with general national and world prosperity. Such studies are the creation of staff management. They assist us in planning our organizational needs, the direction of our research activities, and our cash and plant expansion requirements. It may be of interest to describe briefly our long-range forecasting techniques.

We study continuously a group of economic statistics which have been discovered to have close correlation with the level of activity of our national economy. We also study population economics, that is, growth rates, age distribution and migratory trends and other pertinent economic fields such as weather, changes in living habits, etc. We plot the historic growth trends of our various product lines and check these with our economic history. We then project our future sales growth on a straight-line basis and correct this projection to the economic climate our studies indicate will exist through the next ten years. Our next step is to profit plan each of our product lines as indicated by history and our economic studies and, from these, to prepare estimated earnings statements for each of the ten years in the forecast. Based on the sales estimates, we plot the need for facility expansion and our engineering people estimate for us a ten-year forecast of capital expansion and improvement costs.

With this information, our balance sheet forecasts can be projected. These projections are all made at current dollar values with our estimates of the effect of dollar value fluctuations supplied in an appendix. Quarterly chart reports are presented to management showing the results of our economic studies, budget performance and long-term forecasts.

Our accounting year runs from August through the following July, with accounting periods segregated into equal 13-week quarters, each consisting of two four-week periods and one five-week period. This allows us to have comparable records to study for each week, each period and each quarter, year to

year. In April, we start preparation of our following year's detailed budget, with the objective of having the budget complete by August.

From the long-range forecasts, we will know our next year's profit objectives and the approximate sales dollars which will be required to realize such a profit, but determining the product mix required to produce such sales dollars may be quite a problem and is certainly one that will require the cooperation of all divisions of the management team. In our economy, the vitality which has provided the fuel for our phenomenal growth has been the romance of new things—new things which raise our standards of living and increase our pleasure in living. In most industries that I have studied, usually less than half of the products marketed today were in existence in the same form ten years ago. I know this is true at Campbell Soup Company. Hence, we include in all of our long-rage forecasts an "X" factor for new business.

There must be many participants in sales budget preparation. The research organization will have to assist, for it knows the products expected to be ready for introduction and improvement in the next accounting year. The marketing department must certainly be consulted, for its staff are the experts in determining consumer habits and intentions. Certainly the availability of raw materials and component parts will influence the sales mix and this requires the participation of the procurement organization. Production capacities and engineering developments are vital components of a sales estimate—as are people. This means we must bring production, engineering and personnel into our prognostications. The availability of funds, credit policies and legal problems involve the assistance of the financial and legal staffs.

A company which does not take this approach to planning its year's sales objective sacrifices in my opinion, one of the major benefits of a budgeting program, for the interchange of problems, plans and ideas cannot help but ferment an enthusiasm and esprit de corps that will make fulfillment of the budget plans come closer to attainment. With a sound sales estimate which has been team-made, one of our big hurdles, the estimating of the cost of operations, will have been made easier in a manner which should result in lower estimates. The various divisions of the management team will enthusiastically approach their particular budgeting problems, since one of the important bench marks—sales—will have been established as a result of their own creativeness.

### *Cost Planning and Finalizing the Budget*

We are now at the point where each division and each sub-division of the organization must plan its activities to meet the company's sales goal and estimate their cost of performing it. In our business, this means determining the

tons of tomatoes, the pounds of beef and poultry, the base boxes of tin plate, and the quantities of all materials and supplies that will be needed for our year's activities. It means study of commodity markets by the procurement department at our plants and general office in order to estimate purchasing costs. It means that production schedules must be worked out with the plants and there must be cooperation between plant managements and general office staffs to make sure that people, materials and machines will flow to production operations in a way that will result in the most economical performance. Each general office department must estimate the cost of the services the production organizations expect and must estimate also the expected year's research cost for making this contribution to the company's growth objectives.

There must be no cunning or artifice in the preparation of these budgets. Each division, knowing the company's sales objective, must be relied upon to exercise its own sound judgment in estimating its budgeted cost. It should be expected that each major department head, division manager, superintendent, and foreman will contribute his share to the planning program, for the success of the year's journey will be in the exact ratio to how well they plan their activities and how well they perform them during the year.

It is our belief that too great an emphasis on budgeting as a control tool will deny us many of the benefits available from such a program. Our general office production staff includes an industrial engineering staff and there is a standards department at each plant similarly servicing the line organization in the better utilization of people, materials and machines. This group establishes the standard costs at which work should be ideally performed. This department operates entirely independent of our budget program. We have no conflict, for a man's budget results from his own planned best effort. Our standards operation is a tool provided to assist him in improving on his planned performance.

The job of the budget director should be the easiest of all, for his is the job of accumulating and consolidating all of the sub-plans into the company budget. He should observe and practice the skill of a competent secretary. He should run the show just as she runs your office. He should coordinate, schedule, suggest and assist, but never assume the initiative in establishing another department's budget, for, since he would be helpless to accomplish the required performance, he should never allow himself to be the alibi of another department for failure to meet its objectives.

But, suppose that, when the budget director has assembled all of the subplans, the desired profit objective does not result. Well, then, there is a bit of a problem. In such a situation at Campbell Soup Company, our first approach is for our budgeting group to communicate its problems to our full manage-

ment organization and enlist its cooperation in helping us to "cut the cloth to make the suit fit." If the first stage of the budget planning program has been well executed along the lines we have discussed and our entire management team feels that they have participated fully, we find they will readily re-explore their budget proposals and willingly streamline and re-plan in order that they may make a greater contribution. They will re-plan their cross-country trip to fit our pocketbook. If, after the second review, the profit objective is still unattainable, then top management must enter the picture, for either a lower profit objective must be accepted, some major project will have to be deferred, new sales opportunities developed, or other similar major policies revised.

Our final budget report is a formal one. It contains not only the expected yearly earnings and balance sheet statement but also monthly statements. It includes profit by product line statistics and a wealth of other pertinent budgeted and historic data that permit ready and timely recalculation of the effect of possible researched or economic happenings on our Campbell prosperity.

### *Budget Administration and Performance Measurement*

It should be pointed out that, since each of our plants manufactures our full line of products and since it is not company policy to permit plant managements to alter formulas and procedure, we have always felt it was not a desirable management technique to establish profit centers requiring the proration of budgeted profits over the various departments and sub-departments so that each will know its planned profit contribution. When the budget is approved, the various segments of our management team know that, to make their planned contribution to the company's earnings, they must not exceed budgeted costs. They know that they can make an extra contribution to company earnings by bettering their planned budget performance.

We think that, for us, this is a far better program than one which arbitrarily establishes markups over cost as a basis for determining contribution to successful management. Since each division plans its own operation, we think the challenge is far more productive of effective management than would be the case under a division or departmental profit procedure which would require an arbitrary spread, with which the various members of the team might not agree. Some ingredients are purchased locally at the plants, others are purchased by staff purchasing managers and then allocated to the plants on a basis that produces the greatest company-wide advantages. Occasionally, this policy penalizes a particular department in a way for which it cannot be held responsible. It is our belief that, to over-emphasize profit particularly when it must be artificially allocated is not in our company's best interest.

(Our top management team is not completely "sold" on our method and we are researching for a compromise that will reconcile our quality standard requirements with a profitability approach but we probably will not change our present thinking unless a satisfactory alternative is developed.)

Let us assume that we have established an over-all budget which will give a satisfactory year-end financial statement and that we have approval of our budget planning at the mangement level our policy requires. In our company this is the approval of the president. Now we have the problem of nursing and cultivating our plans into a bountiful harvest. Here is a real challenge to accounting and budgeting men. I am of the opinion that this is the weakest and most undeveloped section of budgeting technology. Few members of management have developed or have any interest in developing the analytical skill necessary to dissect and understand most of our present day accounting reports. This is a problem that will become increasingly greater as office automation progresses for, when you blend machine inflexibility with the normal, natural accountant's ability with "statistical confusion," a most obnoxious concoction results.

Most of us accountants have a tendency to believe that our job is done when the statistical report is issued. We drive ourselves unmercifully in planning, performing and checking our accounting production work and sigh with relief when the final statistical report is off. If we could just place ourselves behind the desks of other divisions of the management team, I am sure we would soon understand that they, too, drive themselves unmercifully in the planning, performance and checking of their responsibility and they too heave the same sigh of relief when their job is finished. If they then have to review voluminous statistical reports at their desks, I am sure, in their positions, each of us would find them just as frustrating.

I contend that accountants will make their maximum management contribution when they acquire the skill to screen their voluminous accounting reports and sift out the few pertinent points upon which their management contemporaries can act and to present this data in a clear, simple, timely form that will make it useable to the recipient. Our budget reporting should have this objective in mind. We should attempt to alert the man to his problems but restrict the alerting to pertinent items and these should be analyzed and reported, pointing to the particular manager's individual needs in order to minimize the time he must take from his other important activities in order to understand and act upon them. The important thing here is to understand the man who is going to use the report to solve a problem. Talk to him, get to know him, understand his reasoning devices and then tailor-make your report to his

individual needs. Acquire skill in this art and I will guarantee you an increasingly important position in your company's management. Point your report at what you would want it to tell you if you were performing your contemporary's task and not at what you want to tell him as an accountant, and you will be the one whose help is sought most in solving management problems.

At Campbell's the report is a simple earnings statement comparing a man's actual performance with his budgeted plan and his performance of a year ago. We do this at the end of each accounting period for that accounting period and for the aggregate of the accounting periods to date. This enables the manager to tell at a quick glance how he is doing. If he has problem areas, we select only the most pertinent for further analysis. We may chart, narrate, or tabulate such analyses, or make any combination of these techniques, depending upon our past experience to indicate what form of presentation the individual finds most useful. We are careful that we present only facts and comparisons to help him solve his problem. It is his budget, his operation, and his follow-up. Our skill is in presenting facts; his in solving the problem.

What should be our budget policy when major non-controllable variances enter our budget picture? To illustrate, Campbell Soup Company has a sometime delinquent with whom it must contend in its planning—mother nature. Our company, through its extensive agricultural research activities, has contributed greatly to the success of farmers in all areas in which we operate. We have, through research, improved tomato strains so that normal yields today are more than three times those farmers obtained from their plantings as short a time as 30 years ago. Most of the tomato varieties grown today for production purposes are products of our research. To insure the healthy vigor of a grower's tomato plants, we gather our own seed, grow our own plants, and sell them to the farmer at cost. We operate soil testing laboratories at all of our plant locations and develop with each grower suggested feeding and spraying programs for his particular fields. We assist him in developing cultural and harvesting methods and constantly strive to improve delivery procedures in order to shorten the length of time he is away from his farm and improve yields for our own production. All of these operations must be planned into our budget, yet mother nature, normally a blessing to us all, can be villainous enough to whip up a hurricane like "Carol" which, in two days time, can result in such a budget variance as to produce a revolution in our budget plans for that year and require a complete re-study of our profit objective.

When a major variance is of such significance as to make the earnings objective unattainable, a revision should be made. Top management should appraise the circumstance, re-establish the company's profit objective, and consult

with those departments in which revision of plans is necessary, explaining the need. In such a revision, as few plans should be revised as possible in order to accomplish the revised objective, but communications should be complete.

It is our feeling that non-controllable variances which are not significant enough to require budget revision should be properly charged in the accounts of the company and the particular division and sub-division should be given a special allowance so that they will not be charged with a negative performance for this event. Such a policy will bring the variances out into the open, alert all concerned to the obstacles to budget performance and yet not deflate an individual department's initiaive in reaching its own planned objective.

Outside influences can also affect budget performance. No person has a "seeing-all" crystal ball. International situations, economic washouts, political developments, competitive landslides and human behaviors all can contribute to the unhappiness of our year's journey. The management team should focus its principal attention on the prevention of human failure. It is proposed that a budgeting system, properly administered, is a means of creating in each person in an industrial organization a warmth for his company that will keep human failures to a minimum. It is natural for people to want to contribute to and be a member of successful management. Participation in a budgeting program and the full communication of the part played will let each man feel the full importance of his assignment to his company's success. No longer can a foreman in a unionized plant operate his responsibility as though it were his own business. He cannot determine the wages to be paid to the men under him or the hours they are to work, eliminate poor performance or reward good performance, set a pace for his workers or do a lot of other things that would allow him to have the proprietory interest in his job that is a major stimulant to successful performance. Is it too utopian to propose that budgeting along the lines discussed here may be a means of helping us to regain such interest from all levels of management?

### *A Part of the Management Art*

It has been the purpose of this article to indicate how we try to apply the budgeting art at Campbell's and what it means to us, rather than to discuss the complete technology of budgeting. Important aspects are the usefulness of budgeting as a management communications device and the opportunity that exists in budgeting to encourage participation of the entire management team in providing a potent incentive to better planning, better performance and better follow-up, which can only result in better and more successful management. Finally, it is emphasized that budgeting provides an opportunity and

a challenge to all branches of accounting for making a substantially increased contribution to successful management through improved reporting techniques, which will provide other members of the management team with reports limited to the pertinent in a clear and concise format on a timely basis, individually tailored to their specfic needs.

There is no doubt that, in line with Webster's definition, budgeting is an art, for it certainly requires skillful planning and the ability to perform by experience, study and observation. Good management will not let it become the art of cunning.

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## LET'S GET PRACTICAL ABOUT RECORDS RETENTION

by W. E. Mitchell*

World War II and the subsequent postwar expansion have created a mass of paper for companies all over the country. Management is becoming more and more aware of this bulk of records that have been accumulating and occupying valuable space for the past 15 years. The top management of our company has recently asked that the same intensive effort that has been applied to reducing manufacturing cost over the years now be applied as well to reducing the costs of office operations. Our retention program is part of this effort.

I blame the popular misconception of the "statute of limitations" (on civil action) for much of the excessive retention periods currently allowed to govern. The "statute of limitations" does not require anyone to keep anything. It simply says that, after a certain period of time, you cannot bring legal action against someone, nor can anyone bring civil action against you. It does not require you to keep records. Therefore, the retention of such records is more for the company's protection than to comply with statutes and regulations. For routine operations, it is felt that three years retention of common detail records is adequate.

Why is it, then, that retention committees slap seven years or more on any record that has an amount of money printed on it? Records pertaining to disagreements obviously should be extracted from regular files and held indefinitely until settlement. It is difficult to imagine routine trade disputes arising after two or three years without foreknowledge of them. If a customer has not paid within a reasonable time, the credit manager is after him right away. So why keep all sales invoices from A to Z for seven years? Likewise, if one of your sup-

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pliers claims you have not paid an invoice, is he going to pout silently for six years without complaining to you about it? If an employee claims he did not receive his last pay check, you will hear about it within a few weeks—not six years later.

The primary objective of a records disposal program is to cut retention down to a bare minimum. Concentration obviously should be directed to high-volume records, of which very few account for by far the greater portion of volume storage. These records, which are common to most industries, are as follows:

1. *Accounts Receivable* — Recommended retention 2 years after date of payment. Of 66 companies surveyed by Record Controls, Inc. of Chicago (1956) 50 per cent are keeping them 15 years or more, with the median retention indicated as permanent! I define accounts receivable for retention purposes to include papers normally associated with them, such as copies of invoices and monthly statements, ledgers, cash remittance advices, trial balancing and aging, papers and correspondence representing routine regular trade (including employees miscellaneous) receivables. Apparently the retention of such records is strictly for the benefit of the company, because Federal and State regulations do not specify them as such.

2. *Sales Invoices and Related Records*—Recommended retention 3 years after date of issue. But 18 per cent of companies participating in the survey referred to, keep them 15 years or more, with the median retention of 7 years. Similarly, I define sales invoices for retention purposes to include papers commonly filed with them, such as copies of original billings to customers, credits, shipping papers, bills of lading, customers' purchase orders, waybills, papers and correspondence representing regular trade sales, including U. S. Government non-renegotiable business. The Fair Labor Standards Act (Sec. 516.6) indicates 2 years; the Interstate Commerce Act also indicates 2 years. Most state sales and use tax regulations indicate 3 years.

3. *Cancelled Checks*—(Trade) recommended 6 years. 33 per cent of companies appear to retain them for 15 years or more, and 50 per cent of the companies keep their check registers 15 years or more. My definition would include bank reconciliations, bank statements, void checks and the corresponding check register, check stubs, or tissue-file copies cross-referenced to them.

4. *Cancelled Checks*—(Payroll)—recommended retention 2 years. It was reported that 19 per cent of the companies surveyed indicate 15 years or more as retention periods. Federal Labor Standards Act provides a two year statute of limitations for claims of unpaid minimum wages or overtime compensation.

5. *Paid Voucher Files*—recommended retention 3 years (the inverse situation of sales invoices for legal purposes). Here, too, 18 per cent of the surveyed companies retain them for 15 years or more. Included in my definition for this classification would be copies of the voucher check, purchase orders, vendors' invoices, bills of lading, papers and related correspondence.

6. *Time cards*—recommended retention 2 years. In the survey referred to, 5 per cent of companies indicated retention of 15 years or more, with a 5 year retention for all those surveyed. Again, the F.L.S.A. indicates only 2 years retention, but other payroll records (such as payroll register or payroll journal) are to be kept at least 4 years.

### Armed Services Procurement

However, the following regulations generally indicate that "books, records, documents and other evidence pertaining to the costs and expenses" of contracts must be maintained by the contractor to the extent and in such detail as will properly reflect all net costs:

1. *Negotiated fixed price supply contracts and purchase orders*

| | |
|---|---|
| Contractors (ASPR 7-104. 15) | 3 years after final payment |
| Subcontractors (ASPR 7-104. 15) | 3 years after final payment under subcontract |

2. *Cost reimbursement type supply contracts*

| | |
|---|---|
| Contractors (ASPR 7-203. 7) | 6 years after date of completion voucher, or settlement of litigation whichever later |
| Subcontractors (ASPR 7-203. 7) | |

3. *Subcontractors whose contracts are other than cost reimbursement type contracts.*

| | |
|---|---|
| (ASPR 7-203. 7) | 3 years after final payment |

4. *Terminated fixed price contracts (supplies or research and development)*

| | |
|---|---|
| Contractors (ASPR 8-701) | 6 years after final settlement |
| Subcontractors (ASPR 8-706) | |

5. *Terminated cost-type contracts (supplies or research and development)*

| | |
|---|---|
| Contractors (ASPR 8-702) | 6 years after final settlement |

# A Study of the Usefulness of Research and Development Budgets

by JAMES BRIAN QUINN

ANYONE WHO THINKS THAT HE CAN CONTROL RESEARCH AND DEVELOPMENT expenditures by means of budget is sadly deluded. The budget is very helpful in planning the program. It has little value in the measurement and evaluation of research output. These are some conclusions the author has drawn from an extensive study[1] he recently completed on the research evaluation systems used by large industrial concerns in the United States. The study consisted of two phases: (1) a survey of over 200 publications relating to this subject and (2) a series of lengthly depth interviews with 60 top research, financial, and operating executives in the largest chemical, pharmaceutical, and electrical concerns in this country.

The selected concerns make up a substantial segment of the total annual U. S. industrial research commitment. The total 1956 sales of these concerns exceeded $32 billion. Their 1956 research and development expenditures were over $900 million, about ¼ of estimated 1956 spending for nongovernment-sponsored research in the United States. The sample of concerns contacted was *not* selected from American industry on a statistical basis. Consequently, the practices of these concerns are not necessarily representative of those of all research supporting American enterprises. However, the consensus of these concerns may be useful to industrial accountants in directing their research control efforts.

1. The study was undertaken as doctoral dissertation research in partial fulfillment of the requirements of the degree of Doctor of Philosophy at Columbia University. The author gratefully acknowledges the financial assistance of Arthur D. Little, Inc. (Cambridge, Massachusetts) whose support made such an extensive survey possible. Some elaborations appear in "The Measurement and Evaluation of Research Results," Copyright, 1958, by James Brian Quinn. Published through University Microfilms, Ann Arbor, Michigan

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### The Budget as a Planning Device

All of the executives interviewed said that the research budget is more useful as a planning device than as a tool for evaluation. No other single planning device presents so complete a picture of the projected research program in a way which is so easy to visualize. Individual work load charts, Gantt charts of individual projects, verbal projections of accomplishment, and summaries of programs in man-hours are all helpful, to a greater or lesser extent, in planning the research and development program. Indeed, all of these devices are frequently used in presenting a proposed research program to the operations committee for approval, but none of them embodies the planning advantages of the budget. Properly prepared, the budget assists (1) in balancing the research and development program, (2) in coordinating the program with the other plans of the concern and (3) in checking certain aspects of non-financial research planning.

### Balancing the Research and Development Program

In planning research for the forthcoming period, the budget can help ensure a proper balance of effort between the areas of inquiry, the phases of effort, and the intended applications of results. It forces management to think in advance about its planned expenditures, both in total amounts and in each sphere of effort. To assist in visualizing the segmentation of the budgeted research program, a research balance sheet has been proposed, as shown below:

Research Balance Sheet*

Planned 1958 Program — X Corporation

*Percentages of total effort by types of research*

| *Phase* | *Cost reduction* | | | *Improved products* | | | *New products* | | | *Total* |
|---|---|---|---|---|---|---|---|---|---|---|
| | A | B | C | A | B | C | A | B | C | |
| Applied research | 4% | 3% | 3% | 2% | 4% | 4% | 1% | 1% | 3% | 25% |
| Development | 5% | 12% | 3% | 4% | 1% | — | 2% | — | 3% | 30% |
| Basic research | 7% | 6% | 2% | 5% | 1 | — | 10% | — | 15% | 45% |
| Total by product lines | 16% | 21% | 8% | 11% | 5% | 4% | 13% | 1% | 21% | 100% |
| *Total by area of inquiry | | 45% | | | 20% | | | 35% | | |

A, B, and C refer to product lines.

* This is a modification of the research balance sheet demonstrated in "Is Your Scientific Research Program Properly Balanced?," *Management Review*, (October, 1952)

Research planners should be careful to make sure that the basic research and development phases of their programs are extensive enough to provide a sufficiency of new knowledge for future development and applied programs. On the other hand, the short-range research and development programs should be sufficient to meet the current and near future technological needs of the concern. Each product line should receive enough of the kind of technological support it needs. Only the budget can aggregate the proposed personnel, material, and plant commitments to be made to each segment of the program.

### Coordinating the Research Program with Operations

No research program will make its maximum contribution to the sponsoring concern if it is not properly integrated into the operating neeeds and capacities of the sponsoring concern. A correctly developed budget assists in coordinating the proposed research program with the other operating and financial plans of the concern. Just how does the budget help achieve coordination? It presents an over-all picture of the proposed research program in a manner which is understandable to non-technical managers and to persons not familiar with the details of the scientific program. These persons are thus enabled to review research plans and to constructively discuss the research and development program—a discussion they could not undertake if all they had to deal with were plans expressed in highly technical terms.

Before the final budget is approved, operating managers review the proposed program, its balance, its costs to their profit units, and its relevance to their activities. At the operating committee meetings where the budget is discussed, operating managers can ask penetrating questions concerning the direction, cost and potential benefits of the program. Research managers are forced to defend their planned programs. "Pet projects" of individual scientists or operating managers come under general surveillance. The adequacies of the program, its cost, and potential benefits are carefully considered by a representative management group before project costs are incurred. Operating managers take a strong interest in obtaining maximum results from the research and development expense to be charged to their operating units. They, therefore, try to make sure that the projected research program will supply the needed technology to fulfill their long and short-run operating needs. Maximum coordination of the program is thus achieved.

The exchange of information which occurs at these planning meetings of the operating committee is perhaps the best "control" top management has over its program. The research director cannot let his eye stray too far from the long-range profit objectives of the concern. Operating executives have an opportunity to make their technical needs known to the research director and he has a chance to make operating managers aware of his problems and of the value and amount of technology his group is supplying. If the operating committee is working effectively, a budget is approved which properly reflects the operating manager's desires to have technology when it is needed and the research director's (and the company's) desire to develop a sound long-range technological basis for the company's operation. The best "control" of research expense is this kind of careful, coordinated project selection, which is greatly assisted by proper budgeting.

In providing operating executives with budget information which will be helpful in reviewing proposed projects and programs, most companies include the following information for each project or program:

| Budget expense last period | Actual expense last period | Actual expense to date | Budgeted expense next year | Total cost through next year | Original project cost estimate |
|---|---|---|---|---|---|

Many companies also include other relevant information, such as predicted project accomplishment, accomplishment to date, potential profit yields, etc. All of this information tends to augment the intra-company coordination achieved in the budgeting process.

Of course, one purpose of research budgeting is to tie in the research appropriation and the projected financial effects of the current research and development effort with the immediate and long-term financial plans of the concern. Clearly there is no substitute for the research budget in anticipating the cash requirements of the research program in the current year. The question of estimating the cash flows which will be caused by exploitation of research results is another matter indeed. No one has worked out a completely accurate method for predicting the timing and amounts of income which will result from current research. However, since this is certainly one of the most vital factors to be considered in integrating the current program into the long-range operating needs and capacities of the concern, it warrants careful thought. Conscientious planning—no matter how inaccurate—is better than no planning at all. Too much current research may create a situation in which the company might not be able to exploit its available technology because of financial limitations or organizational difficulties. Too little research will leave the company without the technological support it needs in future years.

To determine the total amount of research money it should currently be spending and to balance the various segments of its research and development program, one concern said that it was experimenting with "growth curve analysis." The company has developed curves of the investments required by successful research projects in the past. These tend to follow the "S" curve pattern so familiar to market exploitation. Investments are low in the basic research phase, grow slowly in the development phase, mushroom in the applied and pilot plant stages, and level off after initial market introduction of the development. When a sufficient number of such curves have been developed, the company hopes to have a better basis for balancing its program. By coupling its capital forecasts with this analysis, it hopes to be able to tell how much research the company can support. Thus the company hopes to develop long and short-run integration of its research and financial plans.

### *The Budget as a Check on Non-Financial Aspects of Research Planning*

In addition to its uses for program balancing and for integrating research and operating plans, the budget serves as check on the non-financial aspects of research planning. The mere fact that the top research executive must prepare a budget and defend it project-by-project forces him to *think in advance* about major aspects of the program. The overall hiring and pay adjustment plan must be considered, since personnel costs are the dominant factor in research budgets. Individual or group work-loads may be reassessed if it becomes apparent that a particular research unit has had too many projects scheduled for it in the future periods. (The author recalls a situation in which 240 per cent of a scientist's time was committed piece-meal for a year, before a careful budget preparation picked up the inconsistency.) The important balance between technical and non-technical personnel will often show up dramatically in a well-presented budget.

Thinking in advance about capital equipment requirements, special expense materials, or necessary facilities frequently helps to avert problems which might have developed if some formal aggregating plan were not required. Budget preparation and review sometimes discloses duplicate technical efforts. It provides for a routine reconsideration of the important aspects of the research and development program and may lead to the expansion of some projects, the contraction, initiation, or termination of others. It periodically forces research managers to reassess the direction of every project and to inform the scientific staff of the desired new emphasis of efforts. One of the budget's greatest values in planning research and development is that it periodically provides for an automatic review and replanning of all aspects of the program and thus avoids the costs of allowing a program to develop too long "like Topsy."

### *Summary*

The research budget is extremely valuable as a tool for planning research programs. It serves to balance the research and development program, to integrate that program into the needs and capacities of the concern, and to check non-financial research plans. In the preparation and presentation of research budgets, these are the aspects upon which the cost accountant should concentrate. Too often the controllership group regards budgeting as an attempt to set cost standards for accomplishment on projects and programs. It thinks of these standards as useful for the purpose of "controlling" research expenditures during the budgeted period. No concept could be more inane.

### *The Research Budget as a Basis for Cost Control*

In controlling the costs of an operation, a manager must consider two primary factors: (1) whether the operation is producing what it should be producing and (2) whether it is producing its intended output efficiently. Budget vs actual cost comparisons help answer these questions admirably in many operations but not in research and development accounting. The inadequacies of the budget as a research and development cost control device stem from the fact that cost standards cannot be reasonably established for units of research output. Analysis of variances from the budget, as ordinarily practiced in accounting, requires definition of the units to be produced and development of a predetermined cost standard for each unit. Unfortunately, units of knowledge output cannot be defined before the knowledge is obtained, nor can the cost of producing an increment of new knowledge be predicted accurately enough to allow the use of the prediction as a cost standard.

What should the research operation be producing? Executives answer, "technology" or "knowledge." But how much technology? How much knowledge? What form should this knowledge take? No man, no matter how clairvoyant, would be willing to predict the amount and nature of a research program's knowledge output. He could not. If he were able to predict this output, there would be no need for doing the research in the first place. As a consequence, there is no reasonable way to define in advance a unit of research output. Since units of research output cannot be predetermined, there is no way to forecast cost standards for these units. If standard costs for units of output cannot be established, the budget cannot serve as a basis for either saying whether the operation is producing what it should be producing or indicating whether it is producing its output efficiently. Consequently, the budget is not a useful device for controlling costs in the research and development operation. *Not a single* operating or research manager interviewed found the research budget useful as a standard against which to measure the efficiency or effectiveness of the research program. They said that, if a research director so desires, he can "hit his budget on the nose every time." They also point out that such action would not yield the company an optimum return on its research investment.

### *Variances as Measures of Research Efficiency*

Let us see why variances of actual costs from those budgeted are not the same significant efficiency measures as their production cost accounting counterparts. In the strictest sense, it is possible in research and development accounting to

develop: (1) "volume variances" for deviations from the overhead absorption plan; (2) "efficiency variances" which demonstrate how much more or less money than the original estimate was spent on each project during a given period; and (3) "price variances" which show the effects on project costs and organizational costs of unforseen changes in material prices or wage rates. However, these variances should certainly *not* be interpreted as measures respectively, of: (1) the efficiency of the utilization of the fixed assets of research, (2) the efficiency of personnel in attacking research problems, and (3) the efficiency of materials procurement or personnel utilization on projects.

*Volume Variances*—Just as in standard cost accounting, it is possible in research and development accounting to develop "volume variances" by comparing actual overhead expense against overhead absorbed during a period. In research and development accounting, overhead is usually absorbed on one of two bases: as a percentage of project labor cost or as a dollar rate per square foor of space used by the activity. Under either absorption plan, variances of actual overhead cost from the absorbed amount *do not* indicate the efficiency of fixed plant utilization. Research output, i.e., the exploitable technology created by research, depends upon the idea output of individuals and bears no relationship to any cost input factor. Consequently, "volume variances" by organizational units, i.e., the amount by which divisions, departments, etc. exceed or underexpend the standard overhead cost, are not meaningful in research and development since they cannot be related to the output of the organization. Even though actual overhead may substantially exceed the amount the organization absorbs on either a project labor basis or a square footage basis, the overhead overexpenditure may be greatly surpassed by a tremendous increase in research output—a fact which the "volume variance" could not reflect since the basis of allocation bears no relationship to research output. When overhead is absorbed on a project labor basis, "volume variances" of organizational units simply indicate that scientific personnel could not be acquired (or held) at the planned rate. When overhead is absorbed on the square footage basis, "volume variances" simply mean that the planned aggregate overhead cost has been exceeded or underexpended. In neither case does the volume variance measure the efficiency with which the research and development fixed plant has been utilized.

Overhead variancees by projects are no more useful. Variances from charges absorbed by projects on the project labor allocation basis simply indicate that scientists were not assigned to the project at the planned rate. On the other hand, research and development activities are often so fluid in their space requirements that the space utilized by the project may be extremely difficult to determine. Consequently, square footage costs tend to be virtually impossible

to allocate to projects on any accurate basis. In neither event do overhead variances by projects serve as a basis for judgments concerning fixed plant utilization.

Thus, "volume variances"—no matter how computed—are not reasonable measures of the efficiency with which the research and development fixed plant is utilized.

*Efficiency Variances*—Variances of actual research and development labor charges from the planned labor costs can rarely be interpreted as measures of efficiency in project prosecution. First, definite "cut-off points" (or tangible goals) are extremely difficult to establish in any but the most applied phases of research. The more advanced the research, the more difficult it is to establish tangible goals and to compare tangible results of any sort against projected goals. Goals are so indefinite that it is often a matter of executive decision whether a goal has actually been reached. For this reason, projects are often simply budgeted in given areas of work for the entire period of the budget. Concrete goals are often not defined and the attainment of any goal may not be reflected in the accounting system. It would simply be too complex in the advanced phases of research to establish and budget separate projects for each of the myriad sub-goals which are essential to progress evaluation in this kind of research. Thus, analyses of labor time variances become simply comparisons of total time expenditures for an entire period in a sphere of research against the estimates of planned expenditures for that period. The only valid conclusion the analyst could draw from this comparison is that personnel originally scheduled for the project were or were not assigned to it.

Even if goals or sub-goals are clearly established, as they may be in more applied research, conclusions concerning the efficiency of project accomplishment may not be valid. In addition to the difficulties of making accurate time projections, accomplishment of goals is greatly affected by uncontrollable factors. Many research executives interviewed made remarks like the following, "There is always a question as to whether credit for research accomplishments should be given to the scientist or to God." "Pure luck" or "chance" is often a major factor in determining the speed of success of research. Therefore, even if actual time expenditures coincide with time forecasts, the analyst is always left with the question, "Was the research accomplished with efficiency or simply by luck?"

Although the difficulties inherent in establishing concrete goals for research and making valid projections of the cost of looking into the unknown militate against the interpretation of "efficiency variances" in the normal standard cost accounting sense, comparisons of the actual costs of a project against its esti-

mated costs for a period do serve a useful purpose for management. Significant variances advise management to raise questions about the activity on projects which have deviated from their plans. Under- or over-expenditure on such projects may indicate a change in emphasis within the program, concerning which management should be aware. In most cases, the research executive will be asked to justify the change to the satisfaction of management. In this sense, the budget assists in controlling the direction of research, but it is of little significance in *progress or efficiency evaluation.* For the latter purposes, management must depend upon the research executive to explain the adequacies of actual progress against a schedule which only he and his subordinates thoroughly understand.

*Price Variances*—These variances represent the differences in actual and planned unit cost of time and materials. In the case of research and development, "unit" costs refer to project costs. Because of the tentative nature of estimates (caused by the lack of repetition in the operation), unit cost standards are not as meaningful as they are in manufacturing operations. In dealing with the unknown, the scientist is unable to estimate with accuracy his requirements for materials or equipment. As a result, the mix of products actually bought for the project is apt to be so different from the planned mix that price comparisons are meaningless. The labor "price variance" is generally due simply to a change in personnel assignments to the project. These changes in assignment may be reflections of unexpected complications in the technical problem or of changed emphasis on the particular activity. The labor "price variance," intelligently interpreted, does offer research management a measure of the cost of its change of plans. Used in this fashion the labor "price variance" is perhaps the most easily understood and meaningful of the research and development variances developed by standard techniques.

*Organizational Variances*—None of the research executives interviewed considered his ability to stay within the total research and development budget to be a measure of the efficiency of his operation or of his management capabilities. This is simply an indication that the major factor in research costs is labor and that research labor is easily controllable in the aggregate. By hiring or not hiring people, the research director can "control" his total expenses very accurately. However, such "control" could be extremely costly to the concern. The objective of research is to produce technology at a rate sufficiently high to support the growth and competitive objectives of the concern. In evaluating the research effort, therefore, executives rightfully are more concerned with the rate at which applicable technology is coming out of research than with 2 per cent expenditure variances. The function of cost accounting in research and

development control is to warn management that it may have to reappraise the current commitment rate. Cost accounting can help executives observe changes in plans and assess the cost of these changes, but budget vs actual comparisons *do not* enable evaluations of the efficiency or effectiveness of research efforts. These appraisals must be—and are—made by other techniques.

### *Efficiency and Quality Evaluations of Research*

There are no aggregate measures of research efficiency. Efficiency is determined by a series of subjective appraisals, pyramiding from the laboratory or bench level to the top organizational level. At each level of the research operation, a technical supervisor appraises the efficiency of his subordinates in accomplishing some peice of work. No standards are set in advance. They are determined subjectively and after the work has been completed. In making efficiency appraisals, the whole project is broken down into a series of short "blocks" of work. The actual time or cost of each block, i.e., the cost of obtaining partial, complete or negative answers to the various subproblems which must be solved in reaching a major technical goal, is compared by the evaluator against his own idea of what the time or dollar cost should have been. Rarely are written schedules or charts used to express the benchmarks against which progress is checked.

The cost or "pace" standard for each exists only in the mind of the evaluator and is derived from his experience with similar bits of technical work. These blocks may be extremely short. It is only through the evaluator's familiarity with the technical details of the work that he is able to subsection and evaluate the project effort, even in retrospect. Since the blocks used for efficiency evaluation are so short and non-repetitive, they defy the establishment of a formal predetermined standard cost. The validity of the standard thus depends upon the breadth of experience and the objectivity of the evaluator.

The size and value of the blocks of work evaluated vary at each level of the organization. At the bench level, the efficiency of accomplishment of tests, experiments, syntheses, etc. will be appraised. At intermediate management levels, evaluators appraise projects. At the top level, program progress is considered. Subjective time standards, which may not always be compatible, exist at each level. The pyramid of all efficiency appraisals evaluates the efficiency of the total research effort. No successful method was reported for combining these appraisals into a single qualified indicator of research efficiency.

Appraising what comes out of the research program is a question of determining the *quality* of research results. This means their suitability for their

intended use, which is exploitation by the research-sponsoring concern. The adequacy of the knowledge output of research is determined by the skill, creativity, and technical proficiency exhibited by researchers in carrying out their work.

Like efficiency evaluations, appraisals of the quality of research results are presently made as a series of personal evaluations which are pyramided through the organizational structure. These evaluations are made in a manner similar to and generally simultaneously with efficiency evaluations. Since all technical results are created at the bench level, any analysis of the quality of these results must focus on the job performed by the individual researcher or team at this organizational level. Starting with observations at this level, the quality of research is judged much on the same basis as the quality of aesthetic work. An expert or a group of experts appraises the technical skill (proficiency) and/or imagination (creativity) the completed work demonstrates. The experts, in most cases, are the scientific supervisors of the sponsoring concern from both within and without the research organization.

While publications, patents, patent disclosures, etc. form a portion of the total set of criteria used in appraising research quality, the overall judgment of the quality of research performance is highly subjective. The ultimate recognition and application of the criteria used for this judgment occur only in the mind(s) of the individual evaluator (or evaluation group). Competition does provide a check on these subjective judgments. The competitive timing and rate at which patents are issued, new products are introduced, major technological advances are announced, etc. offer a check on the evaluator's subjective judgments of research quality. But even these checks require subjective integration of many variables by the evaluator over rather long periods. While these techniques are admittedly subjective and non-summable, they presently appear to be the only useful way of appraising the adequacy and efficiency of research and development output.

### *What Does Budgeting Really Do for Research and Development?*

In the control of research and development costs, the budget is more useful as a planning device than as an evaluating device. Almost all persons interviewed echoed this feeling in one form or another.

In planning research for the forthcoming period, the budget is helpful in insuring a proper balance by areas of inquiry, phases of effort, and individual work-loads. It forces research management to think about its planned expenditures in advance, both in total amounts and in each sphere of effort. In addi-

tion, the budget review allows top management, functional management, and operating management the opportunity of reviewing the research program prior to its inception. Because budget data are summable, it is possible to more easily observe the proposed balance of the research and development program in this form than in terms of specific technical objectives. Because of these planning advantages and the need to integrate the cash requirements of the research program into the financial plan, almost all concerns use some kind of operating and capital budget for research and development.

Once the budgeted program is under way, the usual actual vs budget comparisons have little utility as measures of research efficiency or effectiveness. Goals are difficult to define and attainment of goals cannot always be objectively established. Estimated time and materials expenditures required to accomplish even concrete project goals are extremely tenous and comparisons with these inaccurate standards should be performed with exceeding care. "Price," "volume," and "efficiency" variances, therefore, have limited direct utility as measures of managerial or scientific efficiency.

The adequacy of research output and the efficiency of output are measured by a pyramid of subjective management judgments. Neither operating nor research managers rely on cost accounting for these measures. While these judgments are admittedly subjective and are not summable into a single measure of the effectiveness of research and development, they are perhaps the most satisfactory currently available techniques for appraising and controlling research output.

## GETTING COST CONTROL FACTS TO SUPERVISORS

by M. L. Black*

THE FEBRUARY, 1958, issue of the *Bulletin* contained the article "An Accountant Draws Some Blueprints for the Foremen", by the late Clair W. Bendel. In this article, the author presented an excellent program for obtaining more accurate recording and reporting of cost data. Recognizing that an accounting system can be no more accurate than its source documents, if such a program accomplishes nothing more reflecting the facts, it is still worthy of consideration. It seems, however, that expanding a program of this nature could provide a direct approach to a better and more effective cost control, as well as improve the accuracy of recording.

It is universally agreed that costs are best controlled at the point of incurrence, and by the person doing the spending. In most enterprises this is not the person signing the checks but the front line supervisor, whose costs are determined from labor abstracts, requisitions for tools and supplies, service and utility consumption, and materials used in process. To properly exercise control over these items of expense, the supervisor must understand and utilize the yardsticks which have been established for measuring his performance. In all too many cases, however, this individual has the misguided opinion that his objective is only to fill the customer's order. He, therefore, must be induced to recognize that filling the customer's order is only part of his objective—it must be accomplished at the lowest possible cost consistent with sound management practices. To attain this objective, the supervisor must be educated and indoctrinated in the basic fundamentals of interpreting accounting reports.

Mr. Bendel referred to his program as "communications". An expanded version, motivated by the ever-increasing necessity for cost control, could well be termed a program of "orientation". Before the accountant can analyze costs for his company, he must orient himself. He must become familiar with its products, its operations, its equipment, and its problems. The same principle is applicable to the foreman or line supervisor. Before he can determine the area in which his efforts toward more economic spending are required, he must be able to understand the basis on which his performance is measured. The problem must be recognized and understood in order to arrive at a workable solution.

A program of this type might be

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initiated with discussions of actual costs—their source and what they represent, how they are incurred, how they are classified, and where they appear in operating statements reflecting cost of operations. Every endeavor should be made to convince the supervisors that they are controlling the company's purse strings, since their approval of labor abstracts, requisitions for tools and supplies, etc., is actually synonymous with cash outlay. This would be the opportune place to emphasize the necessity for accurate and complete recording and reporting. Since there is limited value in cost controls based on trends or experience, the next logical step would be to discuss the need for a means of measuring performance or efficiency. The second phase of orientation then would deal with the development of these yardsticks or measuring devices. Simple illustrations should be used that would carry them step-by-step through the formulation of standards for equipment processing time, good product yields and other cost elements. The necessity for equitable but realistic standards should be emphasized, and participants should be apprised of their responsibility as individuals to insure this requirement being met and maintained. In concluding the program, there should be a correlation of the actual and standard costs, making use of the material previously discussed, and disclosing how these statistics can be used to effect better cost control.

Instructors should be selected on the basis of experience and knowledge of subject matter. Visual aids or "blueprints", such as projector slides, flip charts, blackboards and printed material for distribution, should be utilized wherever possible. One important factor is to set a pace that will assure complete understanding and hold the interest of less receptive individuals, without boring the more alert personnel. Questions should be solicited and answered throughout the entire program and the audience should be encouraged to participate in the discussions. There is one final word of caution. The participants will not be accountants nor industrial engineers and the material being presented will be strange to them. For this reason, instructors should use "mill language" and avoid technical and professional terminology.

Front line supervisors can control costs if accountants will show them how.

# Beyond These Covers

## Books

### Cases in Controllership

*Russell H. Hassler and Neil E. Harlan, Prentice-Hall, Inc., 70 Fifth Ave., New York 11, N. Y., 1958, 334 pp., $6.95.*

Thirty-eight cases developed for use at Harvard Business School make up the contents of this volume, divided into groups illustrated of controllership (5), internal control and audit (10), accounting policy (7), and financial analysis in management (16). The significance of each case is indicated at the start after the assumed name of the company, e.g., "transfer pricing," "measures of performance," " allocation of assets to decentralized divisions."

### Management Creeds and Philosophies

*Stewart Thompson, American Management Association, 1515 Broadway, Times Square, New York 36, N. Y., 1958, Paper Bound, 127 pp.*

Subtitled "Top Management Guides in Our Changing Economy" and identified as A.M.A.'s Research Study No. 32, this study may be a revelation to many who have never associated significant title words with the world of business. The text leaves no doubt that there are companies in which creeds play important roles.

### Internal Audit and Control of a Traffic Department

*Institute of Internal Auditors, 120 Wall St., New York 5, N. Y., 1958, Paper Bound, 87 pp., $1.*

"Intended primarily for those who are interested in the constructive service that the internal auditor can render in his review of traffic operations," this study, which is the Institute's Research Committee Report No. 6, considers (among other factors) routing of shipments, ordering and handling of transportation, and claims. The final chapter and three of six appendices consider the audit program and report.

### Internal Auditing in 1957

*Institute of Internal Auditors, 120 Wall St., New York 5, New York. Paper Bound, 1958, 53 pp., $1.*

Designated as "Research Committee Report No. 5," this pamphlet contains three sections. These are: (1) the results of a survey on internal auditing conducted in 1957, (2) a symposium on "Administration of the Internal Auditing Activity" and (3) a revised "Statement of the Responsibilities of the Internal Auditor," originally promulgated by the Institute in 1947.

### Operations Research Reconsidered,

*American Management Association, 1515 Broadway, New York 36, N. Y., 1958, Paper Bound, 143 pp., $3.75.*

Subtitled "Some Frontiers and Boundaries of Industrial Operations Research," this volume reports proceedings of a conference held last November. Some addresses included, which promise significance to the accountant, are "Operations Research in Cost Control," "Budgeting and Economic Planning," "Simulation Techniques in Inventory Control and Distribution" and "The Use of Operations Research Techniques in Plant Location Problems."

### Stock Control Shortage Manual

*Controllers Congress, National Retail Merchants Association, 100 West 31st St., New York 1, N. Y., 1958, 107 pp., Paper Bound, $7.*

Identified further, by subtitle, as "A study of methods and procedures to reduce inventory losses," this presentation starts by making clear how shortage amounts appear under retail inventory methods and

proceeds to review of controls. In this it covers a wide area of merchandise accounting.

### Managing Geographically Decentralized Companies

*George Albert Smith, Jr., Harvard Business School, Soldiers Field, Boston 63, Mass., 1958, 185 pp., $3.50.*

The broad background of this compact book, plus the case material cited, makes it exceptionally informative on the topic of what decentralization of management takes and how it works out. The chapter on "Planning the Organization Structure" may be particularly relevant to accountants, although the book is in no part on accounting problems.

### Engineering Economy

*Clarence E. Bullinger, McGraw-Hill Book Co., 330 West 42nd St., New York 36, N. Y., 1958, 379 pp., $7.*

Relevance of this work to accountant (although it is an engineering book) is indicated in that portion of its first sentence which states, "Engineering economy has to do with the study of the cost features and other data concerning the activities carried on by engineers. . . ." Among chapter titles are "Operating Cost," "The Minimum-Cost Model," "Financial Analysis," and "Comparison of Alternatives."

### High Speed Data Processing

*C. C. Gotlieb and J. N. P. Hume, McGraw-Hill Book Co., 330 West 42nd Street, New York 36, N. Y., 1958, 338 pp., $9.50.*

"There is probably no technology changing faster than that involving computers and data processors," according to these authors. Their book tends toward the technical, indeed, but contains chapters on "Accounting Applications," "Planning and Scheduling," and "Coding Examples" which are more than certain to interest accountants.

### Business Cycles and Economic Growth

*McGraw-Hill Book Co., 33 West 42nd St., New York 36, N. Y., 1958, 341 pp., $6.50.*

An economics text in an area of conflicting theories, this book will not instruct the accountant in any area of accounting except the background of change in rate of activity against which all business units work. The author notes at the start that "the old fashioned pastime of making business-cycle theories is once more in style."

### Cost Control Through Electronic Data Processing

*Phil Carrol, Society for Advancement of Management, 74 Fifth Ave., New York 11, N. Y., 1958, Paper Bound, 32 pp., $1.50.*

Prefacing this compact review of certain potentials of electronic data processing, the point is made by the author that, with such facilities for getting right answers, the question arises as to ability to ask the right questions. However, if this is achieved, the author finds many services for the equipment, e.g. "electronic data processing can be used to signal changes in cost rates and thus help to speed up cost control."

### A Guide for the Retention and Preservation of Records, With Destruction Schedules

*Record Controls, Inc., American Association of Hospital Accountants, 2630 East 75th Street, Chicago 49, Illinois, 1958, Paper Bound, 46 pp., $2.50.*

Further identified on its cover as "hospital edition," this compact manual covers "organizing a records retention program," Federal and state laws affecting retention of records, "hospital addendum" and a "tabulation of over 250 common papers found in a normal business office, with length of time retained."

**An Approach to Practical Budgeting**

*John P. Rogge, The Controller, June 1958.*

In the view of the author of this article, "the new approach to budgeting has been exercised only since World War II." Descriptive of this approach, the paper largely deals with organizational factors, e.g. the budget director, the budget committee and eight subcommittees.

**The Cost of Capital Functions For a Firm**

*Robert M. Soldofsky, The Controller, June 1958.*

Subtitled, "How to determine the cost of bonds and stocks to get average cost of money uses," this paper is related, in its initial paragraphs, to the currently popular topic of return on investment as a criterion in choosing among alternative managerial actions.

**Facts for Collective Bargaining**

*John W. Hill, The Controller, June 1958.*

Central to this article is a discussion of obligations imposed on companies, with the sanction of the National Labor Relations Board, to provide payroll and profit data to unions in connection with negotiations.

**Review of Defense Contracts for Accountants**

*Paul M Traeger, The Controller, May 1958.*

A practicing accountant, familiar over an extended period with the cost side of defense procurement, here provides a refresher on the topic, which is both summary and comprehensive in character.

**Training for an Accounting Career**

*Paul E. Nye, Charles T. Zlatkovitch, Accounting Review, April 1958.*

Two separate articles, these papers were presented a year ago to the annual meeting of the American Accounting Association and were written from the respective viewpoints of a public accountant and an educator. Mr. Nye stresses the need for a background in liberal arts. Professor Zlatkovitch is concerned that accounting, itself, should be broadly understood.

## *Addresses of Periodicals:*

**Accounting Review**

*c/o R. Carson Cox, College of Commerce, Ohio State University, Columbus 10, Ohio, Single Copy, $1.50.*

**The Controller**

*2 Park Avenue, New York 16, N. Y. Single Copy, 60¢.*